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JOURNAL OF MAMMALOGY

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ON THE HAIR DIRECTION IN MAMMALS

BY WALTER LANDAUER

[*Plate 19*]

In a recent paper in this JOURNAL (vol. 6, pp. 13–17, 1925) F. Wood Jones has given a well illustrated description of the direction of the hair of the kangaroo *Wallabia greyi* Gray. He has shown that on the dorsal and lateral sides of this animal, areas of the hair directed toward the tail alternate with areas in which the hairs are directed toward the head. He has chosen to explain the reversal of hair direction in certain areas of the coat of the kangaroo by reference to the habit of the animal in scratching and combing its hair. "This hair pattern, at first sight, seems to be extremely complex and to be inexplicable on any grounds of utility or of functional demands. But the next step in the inquiry is to take the chart and patiently observe the action of a living animal of the same, or a nearly allied species. . . . . If an animal scratches and combs its fur in the direction of the primitive hair trend it is not to be expected that any change in hair disposition will result.[1] But if it habitually scratches and combs it the wrong way, it will in the end produce, so I contend, those reversals with which we are familiar. . . . . The scratching with manus and pes does not exhaust the methods employed in the mammalian toilet. We have to reckon on the part played by the tongue, by the teeth, and by the horns in different mammalian types. . . . . The part played by the tongue in producing the rhinal

[1] In a primitive marsupial, such as *Dasycercus*, just as in a primitive monodelphian, the hair covering of the body is directed uniformly from head to tail, the free tips of the hairs pointing backwards towards the ground.

reversed tract in mammals seems never to have been realised. . . . . As soon as the hair appears it is arranged in a highly complicated pattern of whorls and partings, convergences and reversals. This complicated pattern is accounted for by the trivial toilet method of the adult." Since these areas of reversed hair direction appear in the pouch embryo before it has learned to scratch or comb he assumes that the hair direction of the offspring has been influenced or determined by the habits of the ancestors. "Yet long before the pouch embryo has need to scratch itself, its coat bears the impress of the scratching done in the idle moments of its ancestors. If this is not a true Lamarckian inheritance of acquired characters it is difficult to conceive what is."

From the last sentences it can be seen that Jones attaches to his hypothesis a general importance for the formation of the hair direction in mammals and for that reason it seems advisable to examine thoroughly the probability of his explanation. Indeed, Jones mentions that many investigations and attempts to explain the hair direction of mammals have been undertaken, but because of the fact that he does not discuss any of these publications it seems probable that he believes that his hypothesis has more general explanatory value than the earlier ones. This renders it necessary to make a brief critical survey of the viewpoints of the different investigators.

In addition to a specific criticism of the Jones hypothesis and a short review of other work on hair direction, I have attempted to formulate a general mechanical or physical explanation derived from the few facts reported up to the present, and from a few new observations which I have made on the hair direction in embryo opossums.

Jones refers to the fact that the hairs as soon as they appear on the skin, show the complicated arrangement which will also be found in the adult individual and therefore he makes the activity of the ancestors responsible for the direction of the hairs in the young or embryo animal. But a fact as well established as the sloping of the hairs from birth on is the observation that the inclination is already established in the first primordia of the follicles during the embryonic development. After Köllicker and Blaschko had first reported this fact, Okamura gave an exact description of the processes involved. He found that "schon von allem Anfang an durch die erste Anlage der Papille die Haarkeime eine schiefe Richtung einnehmen, in welcher sie dann beharrlich weiterwuchern. Was die Haarkeime des späteren Entwicklungsganges stärker geneigt erscheinen lässt, ist der Umstand, dass sie auch in die Tiefe dringend an Länge zunehmen und dadurch eine stärkere Schief-

lage zum Ausdruck kommt. *Einer etwaigen Annahme über die Beeinflussung der Haarrichtung durch das Epitrichium kann ich durchaus nicht zustimmen; denn wie sollte sich ein derartiger Einfluss auf das erste Stadium der Haarkeime*, wo dieselben nur eine einzellige aber bereits geneigte Schicht repräsentieren, *geltend machen können*, da man in erster Linie die seitliche Anlage der Papille berücksichtigen muss."[2] In still another place Okamura writes: "Durch die seitlich angehäuft Zellenmasse in der Bindegewebsschicht, welche der Haaranlage angrenzt, ist gleichzeitig die Anlage für eine seitlich gelegene Papille des künftigen Haares gegeben. *Die Bedingungen zur Schiefstellung liegen sowohl im Epithellager als in dem dasselbe umgebenden Substrat der mesodermalen Elemente.*" Okamura expresses furthermore the opinion that some still unknown fact of ontogenetic nature may be decisive in determining the hair direction. Okamura made his observations on embryos of the rat, pig, dog, and man. His results have been verified in all essentials by Prinzhorn for the dog, by Stöhr for human embryos, and reported also for the mouse by Oyama and for the cat by Backmund. With regard to the causal relationship, however, Stöhr and Oyama assume that the displacement of the cells of the connective tissue does not represent a general rule and especially that it has no peculiar mechanical significance. Recently Prinzhorn has expressed his opinion in the same direction: "Ich muss daher die Behauptung Okamuras, dass die Bedingungen zur Schiefrichtung sowohl im Epithellager als in dem dasselbe umgebenden Substrat der mesodermalen Elemente gelegen sind, dahin einschränken, dass bei weiterem Wachstum des Keimes, wenn er für die Dicke der Haut eine verhältnismässig zu grosse Länge erreicht, wohl auch die Art und Grösse der Schieflage von dem umgebenden Substrat abhängig ist, dass aber bei der *ersten* Anlage des Keims für die Schieflage *nur* die vom Epithellager ausgehenden Druckkräfte massgebend sind, und *dadurch* die Lage der Bindegewebszellanhäufung bedingt ist, nicht umgekehrt. Die seitliche Lage der Bindegewebszellen muss entstehen, wenn sie nicht ganz gleichmässig unter dem vorwachsenden Epidermiszapfen liegen und daher auf einer Seite stärker gedrückt und zur Teilung gereizt werden."

Before entering into a more detailed discussion of the causal factors, it is necessary to have more data from histological investigations on embryos. All the observations concerning the origin of the sloping direction in the hair primordia to which we have referred have been made on higher mammals. Therefore with only the present data it

[2] Italics mine.

would still be possible to suppose that the peculiarities of the hair direction originated in the lower mammals and have thence been transmitted by inheritance to the higher members of the class. For that reason I have studied the development of the hair in an animal of the order of Marsupialia. I had no embryos of the kangaroo at my disposal, but I was able to observe the different stages of the development of the hair in the skin of some embryos of the opossum (*Didelphis virginiana* Kerr).[3] The opossum provides even more favorable material than the kangaroo for the study of this problem since the Polyprotodontia, to which the opossum belongs, are phylogenetically still older than the suborder of Diprotodontia which includes the kangaroos. Figures 1 to 6 are microphotographs of sections of the skin of three different stages in the development of the hair of the embryo opossum from the first primordium (*fig. 1*) to the fully differentiated hair (*figs. 4 to 6*). They show that in the opossum the sloping direction of the hairs makes its appearance in the early primordium of the follicle, namely, earlier than any trace of hair itself. The situation in the opossum seems then to be similar to the condition found by Okamura, Stöhr, Oyama, Prinzhorn, and Backmund in the higher mammals. From this fact we may conclude that we are dealing here with a general peculiarity of the class of Mammalia.

The origin of the sloping direction is not more intelligible from an evolutionary standpoint, even if we disregard the difficulty of imagining any effect on the differentiated hair from the primordium of the follicle, to which Okamura referred with full right. If the inclination of the follicle itself, which appears to determine the definitive direction of the hair, is established so early in development, then we must suppose that we are dealing with a peculiarity of very remote early ancestors of all the recent mammals, because we know from embryological and evolutionary investigations that the earlier appearance of a character in embryogeny means also an earlier appearance of that character in the history of the animal. That these ancestors with an entirely different morphological conformation should have scratched their fur in the same direction is an assumption which really does not need any disproof. If one intends at all to establish such a relationship, would it not at least be more intelligible to say that the habit of scratching in a certain direction has developed as a consequence of the given hair direction because it apparently goes against the grain of the animals, at least

[3] Dr. Carl Hartman of the University of Texas kindly supplied me with these embryos. To him therefore grateful acknowledgment is due.

those with thick and long hair,[4] to scratch themselves against the direction of the hairs? Besides the general sloping direction of the follicles there are many instances in which the hair direction does not coincide with the scratching direction and cannot possibly have anything to do with it. It is only necessary to cite here the fact that on the escutcheon of the cow the hairs are directed dorsad (Jess), and that in man the hair and especially in human embryos the lanugo of breast and neck, above a line which connects the axillae, is directed towards the head and the same holds true for the hair of the upper part of the arms.

We turn now to the other attempts which have been made to explain the hair direction. The first investigator who devoted his attention to these problems was Osiander who found that in human embryos the hair direction on the forehead followed the course of the Arteria frontalis. In general Osiander supposed that electric causes were responsible for the hair direction and especially so for the origin of vortices and other deviations from the normal hair trend. The viewpoints of Osiander failed to be verified later on. Eschricht also suggested that the hairs generally follow the course of the blood vessels. In addition he assumed that the hairs converge to those openings last closed in embryonic development and to elevated points of the surface of the body. Voigt undertook some very remarkable investigations which led him to the conclusion that the inclination of the hair is determined during the development of the hair germs as a consequence of a fixed connection of the distal part of the primordium with the connective tissue, while the inner end is only in loose connection with it. For that reason the hairs must follow necessarily the more rapidly growing surface of the skin and so grow in a sloping direction. Voigt made the further inference that the stretching of the skin does not take place in the same degree on all parts of the surface of the body because in some places a rapid growth of the skin is followed by a rapid extension, whereas in other places (as for example, in the axillary and inguinal regions) a slow growth determines also a slow extension of the skin. Belonging to Voigt this would account for the convergence and divergence of the whorls respectively. According to Schwalbe the position of the hair is an expression of the direction of movement of the animal and of the specific tension exerted on the skin by the section of the muscles used by the moving animal (1911). Primarily the hair of man and the primates has, so he suggests, a caudad direction. Already

[4] As a matter of fact man, a thin-haired animal, scratches usually against the direction of the hair slope.

during embryogeny deviations are caused by the appearance of more or less deep folds in the skin for the anlage of certain parts of the body with the result that the hairs growing inside such folds are directed to the side of the least resistance, namely to the opening of the fold. If the fold subsequently opens the hairs on the one side of the fold have still the original caudad direction, whereas the hairs on the other side show the opposite, cephalad direction, while the hairs near the two ends of the fold have turned laterally. For such areas Schwalbe used the name "Störungsgebiete." Friedenthal also has briefly pointed out the possibility of an explanation of the hair direction by means of mechanical forces such as tension. Finally Kidd dealt with the origin of the hair direction in greater detail and formulated three chief laws determining (according to his statements) the hair direction: (1) The primitive arrangement on the body is from the tip of the snout to the end of the tail, and on the legs from the proximal to the distal ends. The majority of the hairs follow this law and it represents a result of natural selection, a modification or a vestige of an earlier adaptation, which had been useful for the ancestors "as affording the least possible resistance to the passage of the animal through the air, water, burrows, brushwood or any other heterogenous environment" (quoted by Kidd from Thompson). (2) Morphological changes in the conformation of the body may cause deviations from the original arrangement of the hairs. (3) All the other changes (reversed areas, whorls, featherings, crests, tufts) have to be explained as consequences of the influence of physical forces, acting on the surface of the animal. By that of course Kidd means changes following some special use or habit and he says: "The theory of use or habit is equivalent to a mechanical view of the production of hair direction, and must be resolved into certain component parts and diverse forces. These are pressure, gravity and underlying divergent muscular traction." As an especially important action of pressure he had in mind the position of sleeping, but anticipates then also the hypothesis of Jones in the following words: "In considering the action of pressure upon such a tissue as the hair of animals it is legitimate to include with it such others as friction, e.g., in cleaning of fur, contact with grass and undergrowth in woods, dripping of rain on an animal's coat. . . . ." In addition Kidd maintains that the assumption of Voigt is superfluous because "on a surface as such of the human embryo, subject, even before its birth, to constant slight pressure, and much more so in after life, no other than a sloping direction of that portion of the hair which is external to the follicle could occur. If this be so, the portion within the fol-

licle would of necessity be drawn in a sloping direction also." On the other hand some authors have supposed the original and primitive condition is a vertical downwards direction of the hair and they assumed that gravity is responsible for this.

All evolutionary interpretations encounter the same difficulties to which Okamura already has referred, namely that any influence of forces acting on the hair of the first primordium of the follicle is inconceivable. All Lamarckian conceptions, held so emphatically by Kidd especially, explain the hair direction by reference to the habits or activities of the observed animals or of their ancestors, while the early embryological appearance of the definite hair direction would render it necessary to suppose that it originated in very remote ancestors which with their different conformation have doubtless had also entirely different habits. One should recall here the fact that Kidd invokes the habitual posture of sleeping to explain the hair direction on the upper part of the human trunk, whereas the primates have on that part of the body exactly the same hair direction but an entirely different position of sleeping.[5]

To anyone who has studied the hair direction in mammals it will be clear at once that it is impossible to explain its origin by reference to its evolutionary development. We should therefore look for the causes in the embryonic development, and this properly should be the first approach to the problem. Some serious attempts in that direction have been made only by Voigt and Schwalbe. Voigt tried to give an explanation for the general sloping direction, assuming it, as we have already stated, as a passive mechanical result of the events of embryological growth. As plausible as this explanation may sound, it does not do justice to the facts because, like the evolutionary hypotheses, it supposes a secondary change of the hair position. Schwalbe's considerations do not deal with the cause of the hair direction itself but only with the *reversal* of the directions in certain areas of the body. There is no reason to doubt the correctness of Schwalbe's results but their range of application is naturally very limited. Even for the folds of the anlagen of the extremities Schwalbe's explanation may only be granted in some special cases because generally the anlagen of the extremities have appeared long since and developed relatively far before the first primordia of the hair appear. Moreover the reversal of the hair direction in certain areas of the body itself, as described by Jones for the kangaroo, can not in any degree be explained by Schwalbe's statements. The assumption of Ecker and Schein that the growth of

[5] Schwalbe (1911) has given a detailed criticism of Kidd's work.

the bones and the other subdermal tissues influences the hair direction has generally been rejected, but it may be right in certain instances as we shall see later on. Kidd's hypothesis that the degree of development and the action of the subcutaneous musculature (Panniculus carnosus) determine the hair direction may be justified in exceptional cases. Both hypotheses however can certainly not be used for a general explanation of the origin of the sloping direction of the hair.

Without failing to recognize that a definite solution of this whole complex of questions can only be reached by embryological, histological and especially experimental investigations, I shall try to demonstrate that all facts now known can be understood under a uniform mechanical viewpoint and without the aid of evolutionary hypotheses.

In the development of the mammalian embryo there is a period when the skin is loose and wrinkled. Towards the end of that period the first hairs make their appearance, namely, the sense hairs. The follicles of these hairs and the hairs themselves show a straight course vertically to the surface of the skin. During a subsequent period of development the rate of growth of the skin remains behind the general body growth and consequently a gradual expansion and tension of the skin takes place. During the beginning of that period usually appears the primordium of the general hair covering of the body. The passive tension of the skin (Petersen recently has called the skin an elastic network under tension) causes certain directions of strain in the skin, which may take a different course on different parts of the body, depending on the location of the points of highest tension. These points are at least partially determined by the underlying bones and tissues and in this connection the explanation of Ecker and Schein is probably justified. The follicles come under the action of these forces of pressure and strain and the hair germs within the follicles must follow this direction. If the primordia of the first hairs appear a short time before these forces come to activity, we should find among the earliest stages some straight ones, as is actually the case in many higher mammals and also in the skin of the opossum. As development goes on all the follicles and hair follow the direction of strain. There may be possibly slight individual variations in the stage of appearance of the first primordia and this would explain the disagreement between the statements of Okamura and Stöhr with regard to the position of the earliest stages of the primordia of the follicles.

In an extended elastic tissue circular punctures form linear slits with their long axes parallel to the direction of greatest strain. It has long

been known that the hairs mostly take their course in the directions of these planes of slitting (Langer), and this direction is apparently nothing but an expression of the direction of greatest strain. But in certain instances the hair trend and the planes of slitting take a different course. Further investigations are necessary to explain these discrepancies. Burkhart has shown that the planes of slitting change their direction considerably during embryonic development and it is possible that in those areas in which the hair direction and the planes of slitting were originally the same the planes of slitting later change their direction while the hairs remain in their original positions because in the meantime they have formed permanent connections in the subcutis.

If it is true that the inclination of the hair is primarily a function of mechanical-physical forces, then it must be possible to show still other correlations of a physical nature. First we should have to suppose that the thinner the skin is the smaller should be the angle between the outgrowing hair and the surface of the skin, because in an extended elastic membrane the strain produces a greater effect the thinner the membrane is. There is evidence of such a correlation among animals. Stoss for instance reported for the horse that the greatest thickness of the skin is found at the base of the forepart of the mane and that here the hairs emerge from the skin at nearly a right angle; that the skin is very thick on the hollow between last rib and hip bone ("Hungergrube") and the corresponding angle is 45 to 50 degrees; that on the contrary the skin is thin on the flank and the angle is 25 to 30 degrees; and finally that the thinnest skin and the smallest angle (15 to 20 degrees) is found on the cavity between the branches of the lower jaw ("Kehlgang") and here also the follicles are bent above the hair bulb in an obtuse angle. For cattle Stoss reports the following data: on the forehead, where the skin is very thick (4 to 5 mm.), there is a very slight bending of the root, the angle is 60 to 70 degree; on the dewlap the skin too is very thick, and the root only slightly bent, whereas on the cheeks the skin is thin, the roots are very bent and the angle is not more than 45 to 60 degrees.

It would naturally be interesting in this connection to determine whether in man also the same influence of the thickness of the skin on the degree of sloping can be shown. But, strange to say, only one publication by Frédéric out of the whole morphological-anthropological literature contains data which can be used for answering our question. This evidence alone fulfills the necessary requirements, namely that the measurements for the thickness of the skin and the angles of the hair shall have been made for each individual on the same part of the body.

TABLE 1

Measurements from the vertex of individuals of different races as obtained by Frédéric

RACE	MEAN OF THE ANGLE BETWEEN THE HAIR AND THE SURFACE OF THE SKIN	THICKNESS OF THE CUTIS	THICKNESS OF THE SUBCUTIS
	degrees	*mm.*	*mm.*
Japanese	60	1.2	2.2
Chinese	67.5	1.7	2.2
	45	0.8	0.68
East Indian	35	1.2	
	55	1.4	1.84
	37.5	0.92	
	50	2.0	3.0
Tamil	35	0.92	
Armenian	37.5	1.0	0.48
Alsatian	50	0.64	1.48
	40	1.0	
	60	1.08	1.08
Badenese	45	1.2	1.6
Italian (boy)	30	0.52	0.48
Alsatian (redhaired)	60	1.0	
European (redhaired)	50	1.2	1.6
Arabian	32.5	1.0	1.0
Man of the Gafri tribe	35	0.36	0.8
Abyssinian	42.5	0.96	0.44

For these 19 cases the correlation between the thickness of the cutis and the angle of inclination of the hair amounts to[6]

$$r = +0.691 \pm 0.081$$

and for the correlation between the thickness of cutis + subcutis and the same angle we calculate (with $N = 14$):

$$r = +0.697 \pm 0.093$$

We have therefore in both cases, in spite of the small number of data, a significant positive correlation. This means, as was to be expected, that in man as in other mammals the thickness of the skin has some

[6] Correlation tables have been prepared, but are omitted for lack of space. They may be obtained from the author by persons interested.

determinative influence on the degree of sloping of the hair. Frédéric apparently recognized this dependence, since he wrote: "Soviel kann ich behaupten, dass bei einem Chinesen und Japaner, die ich untersucht habe, die Follikel sich durch eine besonders gerade Gestalt, steile und tiefe Einpflanzung in einer dicken Kopfhaut auszeichneten."

Another physical relationship which should be expected on our hypothesis is some correlation between the thickness of the hair and its slope. This also may be verified from observed data. Lehmann, for instance, found that in sheep the downy, fine fibers ("Flaumhaar"), which have a diameter of 9 to 45μ, lie nearly flat on the skin, whereas the kemp ("Grannenhaar") with a thickness of 50 to 150μ are more nearly perpendicular.

Other physical factors may affect the hair direction in special cases as for instance in the sabre-shaped bending of the follicles of the ulotrichi which Unna in negroes ascribes to an abnormal softness and flexibility of the epidermis which invaginates and from which develops the hair.

If it is assumed that the skin of an animal for some reason does not come under the influence of pressure, tension, and forces of strain acting in definite directions, the hair might generally be expected to grow perpendicularly to the surface of the skin. Even if some of the hairs show a slight inclination this is probably a chance occurrence in which case the hairs show no definite uniform direction. Such an experiment nature has actually performed. In the hairless dog the skin is loose and shows folds somewhat resembling the convolutions of the brain. Prinzhorn, who made careful investigations of the skin and the hair of such animals reported as follows: "Als einen der auffallendsten Unterschiede gegenüber den von Okamura und mir beschriebenen Anlagen ist festzustellen, dass, wenn auch einige Haarkeime schräg ins Corium dringen, *die meisten* doch *senkrecht ins Bindegewebe wuchern; einige* finden sich auch *die leicht gekrümmt sind*, und die schräg angelegten *bevorzugen durchaus nicht eine Richtung*. Die von mir als im Epithellager bei Hundehaaranlagen angenommene gleichsinnige Richtungsbestimmung ist also hier nicht vorhanden und hat einem mehr oder weniger direktionslosen Wachstum Platz gemacht."[7] This may be regarded as verification of what was to have been expected on our hypothesis: in the case in which the skin is not under tension the majority of the hairs grow perpendicularly to the surface of the skin and the few sloping hairs are distributed by chance with regard to the direction. It is significant furthermore that in the animals observed by Prinzhorn the

[7] Italics mine.

head had usually a normal tight skin as well as a normal hair covering and that the hairs of the head showed a normal sloping direction. Prinzhorn also found in one exceptional animal, in which the appearance of the skin and of the hair was nearest to normal conditions, that all primordia of the hairs and the hairs themselves showed the sloping direction normal to areas of skin tension.

A problem considerably more difficult than the hair slope and its general direction is raised by the vortices. It seems probable that we are dealing here with very heterogenous things. The roughness of the hair in guinea-pigs has clearly been demonstrated by Castle, Wright and Pictet et Ferrero to be a Mendelian character. In these animals the whole body is divided into more or less definite areas, from the centers of which the hairs diverge in all directions (rosettes). On our hypothesis it must be assumed that we are dealing here with a factor which regularly *disturbs* the development of the normal hair direction during embryogenesis. It seems to me very questionable if the whorls occurring in most of the mammals in certain areas, which also have a somewhat different morphological appearance than the vortices of rough-haired guinea-pigs, have anything to do with inheritance in a narrower sense. Bosch has already demonstrated in very instructive experiments on skulls of the horse that the direction of the hairs in the whorls is exactly in agreement with the direction of pins in a piece of caoutchouc which has been placed on a suitable base and has been extended in certain directions by suspension of weights. In the center of such a field the opposite forces of strain compensate each other and accordingly the pins, like the hairs in the center of the whorl, have a vertical position. Bosch believes that the corresponding forces on the skin of mammals are exerted by the musculature. It seems to me more probable that the points where whorls appear are merely those points which represent the centers in which forces of strain acting in different directions meet each other. The mechanical explanation of course will not be changed at all by this different interpretation. In this connection may also be mentioned the observation of Rast, who found four horses with the habit of cribbing or wind-sucking in which the lower whorl of the neck had been greatly enlarged. Rast assumed that following the hypertrophy of certain muscles as a consequence of the cribbing a stronger strain was exerted by these muscles on the overlying skin. A general correlation had been established by Bosch and Rast between the amount of muscle substance present and the number and distinctness of whorls. It seems probable to me that the conditions of the musculature are only the

secondary cause for the appearance of the whorls and that the muscles act on the hair direction only through their influence on the pressure and tension of the overlying area of the skin. The same mechanical factor, namely, tension, apparently operates also on areas of the body from which some time later an organ breaks through the skin. As an example of this may be cited the fact that in calves a distinct hair vortex is found on the areas where later the horns break through the skin. In hornless cattle these vortices have not been found.

Besides strain and pressure other physical factors such as the thickness of the hair (Bosch and Bethcke) may influence the differentiation of the whorls, just as they influence the hair direction. Niedoba (1917–18) working with pigs and horses and Siegel with dogs tried without result to find racial differences with regard to the appearance of the whorls. Niedoba (1923) reports that horses which have two whorls side by side on the forehead frequently have parents with one whorl each, the whorls occupying different positions in the two parents. He has assumed that each whorl is inherited separately. The most probable interpretation for that is apparently that the inheritance of an intermediate conformation of the head is responsible for the appearance of two whorls, each of which corresponds to one of the parental ones. The fact that the size and situation (with regard to the longitudinal position) of the whorls in the mule are intermediate between the conditions in the horse and the ass may purely be interpreted as an intermediate conformation; but of course analytical experiments would be needed to settle the question. Bolk has reported that in dicephalic monsters of human embryos the hair slopes in the frontal region may show "considerable differences in the two heads," whereas in the case of a directly inherited condition a close similarity should be expected. This condition also might be caused by differences in the conformation of the two heads, arising from abnormalities in their relative position.

With regard to the factors determining the hair slope and the direction of the hair generally the sentence of Wilder is still true that "there has been as yet too little morphological work in this field to allow much theorizing or to serve as a basis for definite conclusions." Nevertheless I hope that I have been able to demonstrate that in general the results of investigations up to the present may be summarized and understood under uniform physical viewpoints; that the general sloping direction of the hairs is apparently merely the expression of embryological mechanical action on the skin, influenced by such physical factors as thickness of the skin, thickness of the hairs and so on; that such deviations from the

hair direction as the common whorls indicate the points of greatest tension and the centers of divergent stresses modified, like the hair direction, by various physical factors. There is still much to be done in this field and the best results may be expected from cases in which distinct deviations from the normal appearance of the fur are found, as in the *Nasua rufa* described by De Beaux.

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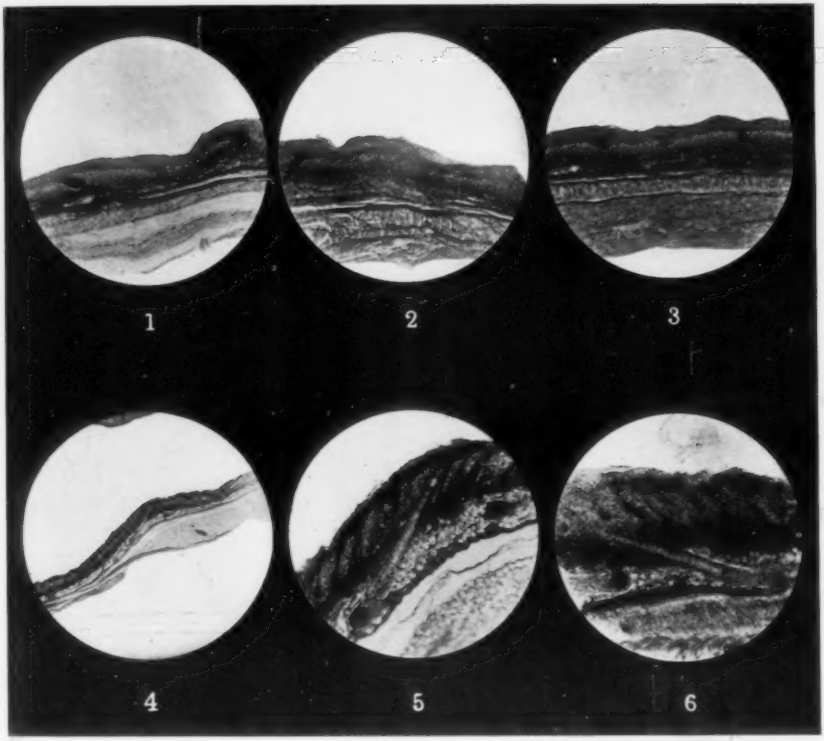

LONGITUDINAL SECTIONS THROUGH THE SKIN OF DORSAL SIDE OF EMBRYOS OF DIDELPHIS VIRGINIANA KERR.

The embryos were fixed in Bouin's fluid. Staining: Van Gieson-Weigert. The pictures were made with the Zeiss Phoku. The direction of the follicles and hairs is the same in all sections. Differences in the direction of slope in the figures are due to the absence of uniform orientation in some sections which did not remain fixed in the slides.

Fig. 1. Section of the skin of an embryo of 40 mm. length from the snout to the base of the tail. Two hair primordia showing a slight sloping direction can be seen. Figs. 2 and 3. Sections of the skin of an embryo of 46 mm. from the snout to the base of the tail. Primordia somewhat more developed, showing distinct sloping directions. *Figures 1 to 3* have been prepared with the Zeiss apochromat 20 and Phoku eyepiece L. Figs. 4 to 6. Sections of the skin of an embryo of 75 mm. length from the snout to the base of the tail. Most of the follicles are fully differentiated, and some hairs are already to be seen on the surface of the skin. *Figure 4:* apochromat 10, Phoku eyepiece L. *Figure 5* is part of the same section as *figure 4* with apochromat 20, Phoku eyepiece L. *Figure 6* has same magnification as *figure 5*.

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FLASHLIGHTS OF SMALL MAMMALS

BY TAPPAN GREGORY

[*Plates 20–21*]

In October, 1924, I spent about three weeks with my brother, Stephen S. Gregory, Jr., and Charles H. Hodges, Jr., in northern Michigan, photographing such individuals of the various kinds of wild life, indigenous to the locality, as we could induce to trip our set cameras. Our headquarters were on the south shore of Lake Superior. We were in a wooded country of many small inland lakes and low hills (the highest rising perhaps a thousand feet) from which most of the white pine has been cut, leaving scatterings of Norway and jack pine, hemlock, balsam and cedar, and the rest hardwood. Half a mile from Lake Superior lies Pine Lake, on the shores of which we obtained all our results. Pine Lake is about nine hundred yards from north to south by perhaps a little more east to west, the shore line varying among green timber, rocks, dead-wood caused by lumbering operations, and sand beaches.

At first we had only one camera available but this was shortly supplemented by another so that during all but the first three or four days and nights of our stay we had two "sets" out all the time. Our method was as simple as possible. The trip wire connected with a break in an electric circuit in such a way that slight pressure caused it to close this break, permitting the current to ignite a gunpowder fuse which exploded a charge of flash powder, the whole an instantaneous operation. The cover of the flash pan connected with a shutter prop. Upon the explosion, this prop was automatically jerked out and the shutter, operated by a coil spring, was released at a speed of 1/200 second. Flash and shutter were synchronized to give the exposure at the interval of maximum

efficiency of the light. This arrangement has given us good negatives in daylight and at night as well as in the early dawn and the dusk of evening.

The first week we spent all our time on the deer with practically no success. They were plentiful and hardly a day passed but that we saw from one to five or six on our various trips through the woods, no matter what direction we took. Although good "leads" were chosen and the sets left for several days untouched or shifted from time to time as the signs seemed to dictate, results were negligible. Carrots, potatoes and apples seemed to hold nothing of interest. We did obtain one shot of a very small animal in full flight over a log, but it was unsatisfactory. On that particular set we gambled on a more or less head-on view and lost. This was early in the evening of October 10, a cold night with the mercury below 40°F. Apparently the deer were scattering and not travelling their well worn runways with any regularity.

Crossing Pine Lake on the 14th, we caught a pickerel of about one pound and a half weight. It was killed and without being handled was laid on the sand beach of one of the small bays of the lake. Later in the afternoon, an hour or so before sundown, we drifted idly on the bay watching a mink foraging along the shore and in and out of the water. It retrieved a crawfish or other similar crustacean on one of its submarine cruises and pulled up in the shelter of a low hanging bush at the very water's edge to devour it while we sat quietly interested six feet away. During some of the animal's nervous expeditions on the surface of the water, it swam within a few feet of a small muskrat, apparently unmindful or ignorant of its presence. The muskrat sat hunched up on a branch of a beaver's under-water brush pile, in plain view on the surface, quite motionless while the mink was near, but whether asleep or awake we could not tell. A visit to the beach the next morning disclosed the disappearance of our bait. Mink tracks in the sand and the mark of the dragged fish told the story plainly. The mink had taken his find into seclusion well back under some logs. No remains were visible. That day, the 15th, we caught another pickerel of about the same size, placed it where we left the first one, and moved one of the set cameras to it, stretching the trip wire along the length of the bait and about half an inch above it. Our reward was a splendid negative of a large, white, feral domestic cat. The tracks were amusing. Its first jump brought it down with claws extended and dug deeply into the sand about six inches from the previous position. Thence it headed inland at high speed and never again ventured near the camera! Thereafter, efforts with deer were abandoned and we set the second camera

with another fish on another sandy stretch on the south shore of Pine Lake. Three nights later, October 18, in the early evening, we heard the dull boom of the charge and saw the welcome flash of light in the sky. The negative was picked up at once and the tracks studied. A mink had come to the bait on a diagonal from the water's edge several yards away, had pressed the trip wire with its head (this showed after development of the plate later in the evening) then turned in the general direction from which it had come and plunged into the water in frantic leaps, to come out onto the sand again within a few yards. The fish at that time had only just started to spoil. Although exposed to the sun, it was partly covered with sand and the temperature of the air was low enough to aid preservation in a measure.

On the night of the 20th a skunk visited the first set and left us a good picture of its back. It came to the same bait which had attracted the mink. Meanwhile mink had twice sprung our second set across the lake, once on the 15th and again on the 17th. Neither picture was satisfactory, however, and it was difficult to read the tracks accurately because of the gravelly nature of the beach. Soon after that we began getting skunk pictures at this set too, the first visit resulting in the complete disappearance of our bait. By this time the fish at our first set was also used up and in spite of earnest effort we were unable to catch another. We tried fresh meat which attracted the skunks but nothing else. Another good shot, this time a front view, resulted on the 22nd. This picture shows that the skunk ran into the trip wire before finding the bait, which the next morning was gone. Apparently the flash did not bother the skunks much as they almost invariably ate all the bait, dug around for more and then trampled down the area all about the camera as well as where the bait had been. We identified at least three different individuals and obtained a number of negatives not worth saving. The animals came to the sets so early in the evening that we really had no chance at anything else once they had found our offerings. This induced us to move both sets. Thereafter we had two cameras on our first bay, sheltered from each other by a slight promontory. From then on, number one set brought us nothing but a robin. Still unable to get another fish, we resorted to the heads of some good sized lake trout which had been shipped in for the table.

During all this time we had been watching the work of a beaver, seeing the animal itself from time to time swimming at sundown to add another lot to its winter food supply. There was a house on the north side of a point which formed the southern shore of our little bay and on

MINK AT FISH BAIT ON LAKE SHORE. OCTOBER 18, 1924

BEAVER FLASHED IN ACT OF CARRYING CUT SAPLING. OCTOBER 25, 1924

SKUNK AT STALE FISH BAIT. OCTOBER 20, 1924

SKUNK AT MEAT BAIT. OCTOBER 22, 1924

top of this point we found fresh cutting and several slides down the gradual slope to the water. There were no indications that more than one beaver occupied the house at this time and the one did not appear to pursue any regular method in gathering food, sometimes cutting near the house and again wandering to the far side of the point a couple of hundred yards away. On occasion we found its tracks in the sand near one of our cameras, where it had sat near the water the night before. No mud had as yet been plastered onto the outside of the house. When we visited the cut-over area near the house on the morning of the 24th, we found a black birch log freshly cut, and still untrimmed of its branches, lying at the head of one of the slides. The opportunity for a picture looked rather favorable, but we finally concluded to leave our cameras out for mink one more night. That night a mink came along the beach right toward the fish head, but, when within four feet of the bait, turned and crossed the wire on the run too close to the camera, ignoring the fish entirely, and continuing on diagonally toward the water. The shutter was not fast enough to save the picture. The next day, as the beaver's birch log lay as before, except that the branches had all been taken off and disposed of, we lost no time in transferring one of the cameras to this slide where we found it duly sprung the next morning, and the log in its proper place in the brush pile. Either the beaver, with great intrepidity, continued with his burden after the flash, or else mustered sufficient courage to go back and pick it up before we arrived in the morning, unless, of course, some other beaver came long to lend a hand. Hopeful of another chance, we reset in the same spot. In the twilight of the evening of the 26th, the wire was tripped by a partridge and when we examined it, there was such a sag that we reached the erroneous conclusion that an animal of some weight must have passed over it.

Our time was now short so we picked up both cameras and reset them on the bank of Pine River which flows from Pine Lake past the camp into Lake Superior. Here a number of beaver were at work cutting and stacking their boughs and logs. We could find no nearby house occupied, nor was there any at all close to their two submerged brush piles. We found them felling and cutting up numbers of jack pines and discovered among these one small white pine. One camera was set that night by a partially cut jack pine at the top of the river bank, the other at the foot of one of three slides beside which stood a jack of about ten inches diameter. Considerable preliminary cutting had been done on this tree but it had not been revisited when we left. Nothing came

through our wires that night, so we shifted one set to the top of a slide and heard the flash go shortly before daylight of the 29th. The picture was a failure because again the shutter was not fast enough. It was only interesting because the image in the negative made it appear as though the beaver had leaped out onto the steep slide from the top. We could not verify this from such an imperfect plate. That was our last shot and concluded a most entertaining experience with these few interesting subjects.

Chicago, Illinois.

ON THE NATURE OF MODIFICATIONS OF THE SKIN IN THE STERNAL REGION OF CERTAIN PRIMATES[1]

By George B. Wislocki and Adolph H. Schultz

[*Plate 22*]

In 1921 one of us[2] reported the occurrence in orang-utans of a structure situated on the chest which he designated as the sternal gland. This consisted of a small, circular pit situated in the midsagittal plane, slightly above a line connecting the nipples and overlying the manubrium sterni. Into this pit there opened a considerable number of large sebaceous glands.

The sternal gland was present in 12 out of 13 males, but in only 2 out of 10 females. The two females in which it occurred were juveniles. The male in which it was absent was a very old specimen. Moreover, the gland was always relatively smaller in fairly old orangs than in juveniles. Furthermore, the gland was most evident in fetuses, appearing first at about the middle of the period of fetal life.

[1] This paper is one of a series of reports on material obtained from Nicaragua in 1924, by an expedition from the Johns Hopkins Medical School. The personnel of the expedition consisted of Drs. A. H. Schultz, G. B. Wislocki, F. F. Snyder and Mr. O. O. Heard. The expenses were defrayed in part by a grant from the Linton Fund of the Johns Hopkins Medical School. This Fund was established in memory of Dr. Edwin S. Linton, a graduate of the Johns Hopkins Medical School, who lost his life in France, in 1918, while serving with the American Forces. An additional grant was generously contributed by the Carnegie Institution of Washington.

[2] Schultz, A. H., 1921. The occurrence of a sternal gland in orang-utan. Journ. of Mammalogy, vol. 2, pp. 194–196.

The opening of the sternal pit was umbilicated and as a rule circular, although in some instances it was oblong, in which case the longest diameter was horizontal. In the older specimens the margin of the pit was markedly pigmented.

The sternal gland of a male orang fetus was sectioned. It was found to consist microscopically of a number of large sebaceous glands emptying into a short canal which opened in turn into the spacious pit at the surface. The sweat glands beneath the sebaceous ones were unusually numerous and of more than average size. In several cases microscopically fine hairs were observed on the edge, and in one instance at the bottom, of the pit.

In conclusion it was stated that, on examining a considerable number of preserved bodies of fetuses and adults of many different species of monkeys and apes, no trace of any similar structure was found.

While we were in Nicaragua collecting monkeys, our curiosity was aroused by a peculiar structure observed on the chest of the spider monkey, *Ateles geoffroyi*. This consisted of two small, unpigmented, slightly elevated areas of skin symmetrically placed about 1 to 2 millimeters to either side of the midline of the body, at the upper edge of the manubrium of the sternum. This structure occurred uniformly in some 59 specimens which we secured, consisting of new-borns, juveniles and adults, both male and female, besides two fetuses near term.

The suspicion was awakened that these structures might be glandular in nature, and that they might resemble the structure previously observed in the orang. Hence, we undertook to ascertain their morphology and to compare them histologically with the sternal gland found in the orang. A number of the areas of skin of the spider monkey were fixed in either Bouin's fluid or in 10 per cent formalin.

For comparison, the serial sections of the sternal pit of an orang fetus were reexamined, besides the sections of a specimen from a recently acquired adult male orang. This latter specimen has proved much more valuable in ascertaining the nature of the structure in question than the fetal material.

In the spider monkey (*Ateles geoffroyi*) one observes two circular, white areas of skin over the manubrium of the sternum which are, as a rule, slightly elevated and have a diameter of from 2 to 4 millimeters. Their margins are distinct, due to the abrupt termination of the pigment characteristic of the surrounding skin. The chest is set with sparse, long, wavy, yellowish hairs, but these are absent on the two unpigmented

areas in question. On examining the spots carefully one observes on each, in place of the long hairs, a tapering tuft of closely set, short, delicate, colorless hairs. On taking the skin of the areas gently between the fingers a subcutaneous nodule can be felt.

On examining the areas under the low power of the microscope, they are seen to be composed principally of aggregations of glands situated in the corium and the underlying subcutaneous tissue. Overlying them in the corium one sees numerous small hair follicles associated with small sebaceous gland (figs. 2 and 4).

The epidermis is relatively narrow in this region and consists of only two distinct layers, the stratum cylindricum and the stratum corneum. It differs nowise from the adjacent epidermis of the chest except in the absence of pigment in the stratum cylindricum. It is perforated by numerous small hairs.

The epidermis unites with the corium to form a slightly irregular line except when it is interrupted by hair follicles. The papillae of the corium are absent in this region, as well as over the rest of the chest. The corium is rather narrow and in it rest the follicles and sebaceous glands of the small hairs characteristic of the sternal areas.

Between the hair follicles, but predominantly below them, in the deepest layer of the corium and in the superficial subcutaneous tissue, lie the aggregations of glands (fig. 4). From examination of our sections we are led to believe that there are two varieties of glands, the one a simple tubular gland, the other a branched tubular gland. The former consists of a spacious coiled tube which leads via a narrow curved outlet to the surface of the skin. The coiled portion of the tube is five to ten times as great in diameter as its duct. The transition from the spacious, coiled portion to the narrow duct occurs abruptly, producing a funnel-shaped junction. The gland is lined by a simple layer of epithelium, which is quite uniform and low in the neck portion, but of variable height in the coiled portion. The epithelium of the coiled portion varies from a high columnar one in some glands to a low, flattened one in other glands. In the former, the cells form a thick cylinder around a relatively narrow lumen; in the latter, they constitute a thin ring around a wide lumen. The glands of the latter type are often greatly dilated. Glands in all transitions between these two phases can be made out. The lumen of the glands with high epithelium contains eosin-staining droplets of secretion of considerable size; secretion in the dilated glands fails to stain as a rule, although, in some, a barely visible eosin-staining flocculent precipitate is visible.

The branched tubular glands differ in appearance from the simple tubular ones. They lie for the most part below and at a deeper level than the latter and are far less numerous than the simple tubular glands. They consist, as a rule, of a number of small, irregular openings imbedded in rather compact connective tissue, possessing somewhat the outline of a lobule. The tubular or alveolar openings, as one may choose to call them, connect with a large space resembling an atrium or collecting duct, which eventually leads to the surface as a narrow tube. The epithelium of the alveoli is as a rule cuboidal or flattened, but sometimes so vacuolated that the cells protrude irregularly into the lumen. Now and then the epithelium appears to be double layered, the superficial cells dropping off into the lumen. The collecting space is, as a rule, lined by a similar kind of epithelium, although, in places, particularly where the collecting tube converges toward the narrow neck or outlet of the gland, its epithelium becomes high and narrow, the cells crowding one another and projecting with club shaped ends into the lumen. These glands, similarly to the simple tubular ones, appear to be subject to a variable degree of dilatation and hence to changes in the height of the lining epithelium (fig. 4).

The structures we have been describing resemble sudoriparous glands, but in order to determine whether they are special modifications characteristic of the sternal region in question, or whether the sweat glands of the spider monkey are all of the same general character, we have studied sections of other parts of the chest. We arrived at the conclusion that the sweat glands in this species are conspicuously large and complex in other parts of the skin and, moreover, that everywhere they are subject to considerable variation in the diameter of the lumen and the height of the epithelium. However, we were not able to find the branched tubular glands in other portions of the skin. So that these remain, as far as we could ascertain, characteristic of the areas in question. Moreover, aside from this, the sternal areas exhibit a much greater abundance of sweat glands than the other areas of skin which we have examined. And finally the glands in these areas are subject to greater dilatation than elsewhere, amounting in several instances to almost a cystic transformation. To one familiar with sudoriparous glands in the human skin, these glands in the spider monkey are singularly conspicuous and complex.

We shall now pass to a description of the microscopic appearance of the gland-like structure in the sternal region of the orang-utan. No further mention need be made of its incidence or gross characteristics

which have been fully described in the previous paper. However, its microscopic character requires some comment, especially since the specimen recently obtained from an almost adult orang sheds more light upon the nature of the structure than was obtained originally from a study of the sections of the fetal specimen. This specimen is from a male orang, aged seven and one half years, which died at the National Zoological Park. The gland was fixed in ten per cent formalin, sectioned, and stained in haematoxylin and eosin.

The sections under low magnification reveal an opening on the skin with a diameter at its mouth of about 2 millimeters (figs. 1 and 3). From this opening, a narrow, slightly irregular tubular invagination projects downwards into the skin for about 6 millimeters. This invagination is slightly broader in its deeper or fundic portion than near its mouth. It is lined throughout by epidermis, continuous and identical with the surface epithelium. Similarly, as in the epidermis of the adjacent skin, the stratum cylindricum and the stratum corneum can be identified. A slight pigmentation of the stratum cylindricum is characteristic of the surface epithelium, as well as of the epithelium lining the sternal invagination. As many as 20 to 30 sebaceous glands are clustered around the invagination into which they open (fig. 3). There appear to be many more sebaceous glands present in reference to a given surface area of the invagination than occur per unit area over the adjacent surface of the chest. Several of the sebaceous glands are associated with short hair follicles, the hairs of which protrude into the lumen. It is, however, impossible to demonstrate a hair follicle in association with the majority of the sebaceous glands. The lumina of these glands appear to be markedly dilated by contrast with what are probably normal glands associated with hairs on the adjacent surface of the skin. Several of the largest of the sebaceous glands open into the fundus of the invagination.

The lumen of the invagination is filled with secretion and detritus.[3] The former is derived undoubtedly from the sebaceous glands as well as from sudoriparous glands which open into it. The detritus consists of the desquamated horny elements of the epidermis as well as of fragments of broken-off hairs (fig. 3).

In keeping with the invaginated epidermis, the corium upon which it

[3] The orang, from which this gland was obtained, was examined alive in 1921. It was found, as mentioned in the first paper, that a glandular body, the size of a pea, could be felt beneath the sternal pit. On palpation a drop of clear fluid exuded from the opening.

rests is also infolded. The hair follicles and sebaceous glands which have already been described are situated in this layer. Besides these, there are numerous sudoriparous glands in the deeper layers of the corium which communicate with the lumen of the invagination by narrow ducts. These sweat glands are simple tubular structures with a coiled portion deep in the corium and a simple bent tube which leads to the invagination. The width of the tube in the coiled segment is slightly greater than the width in the neck segment. The gland is lined by low columnar epithelial cells; the lumen contains granular secretion. In one instance, the coiled portion of a gland appears to be somewhat dilated. The corium around the fundic portion of the invagination is in several places densely infiltrated with mononuclear cells resembling lymphocytes.

Our study of the structure of the specimen from the adult orang simplifies an understanding of the fetal specimen. In the latter the invagination is just developing and is scarcely more than a superficial invagination of the epidermis. It consists of a shallow pit which at its bottom leads into a short, narrow canal lined by epidermis. Into the canal several large dilated sebaceous glands open. The entire pit, as well as the skin immediately surrounding it, is richly beset with small hairs. Most likely these and their attendant sebaceous glands become incorporated gradually into the growing invagination. In the corium beneath the pit there are numerous sudoriparous glands, a number of which are markedly dilated.

DISCUSSION

We are dealing in the spider monkey and in the orang with quite different modifications of the skin of the sternal region. In the former, the modified area occurs bilaterally, is slightly elevated, and is present regularly in both sexes. In the latter, it is single, situated in the midline, consists of a pit or invagination in the skin, and occurs chiefly in the male.

Histologically, there also is no resemblance between them. In the spider monkey, the areas differ in character from the skin of the rest of the chest principally in the presence of numerous small hairs and abundant, somewhat modified sudoriparous glands. In the orang, on the other hand, the structure is clearly an invagination of the skin affecting the hair follicles as well as the underlying sebaceous and sudoriparous glands. The structures can not, therefore, be considered as analagous in nature.

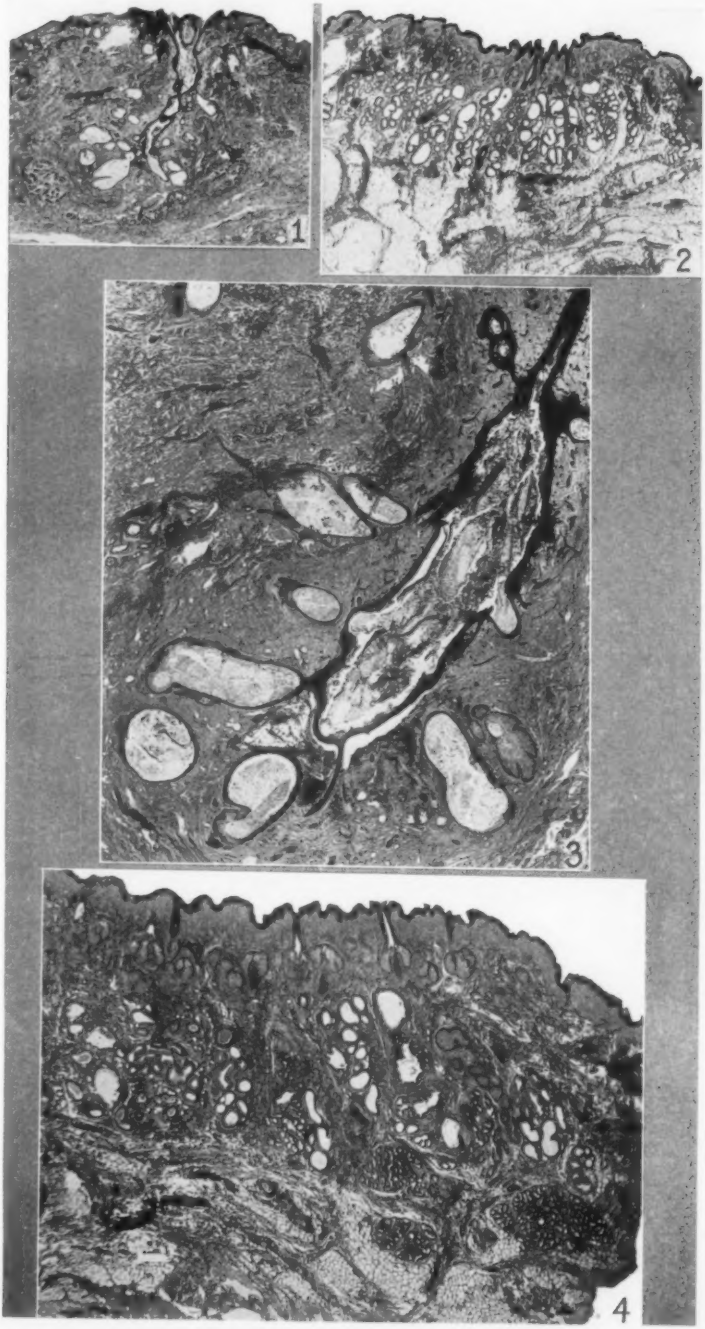
EXPLANATION OF PLATE

FIG. 1. Low magnification of a section of the skin of the chest of an adult orang, showing the sternal invagination. × 4.

FIG. 2. Low magnification of a section of the skin of the chest of an adult spider monkey, showing the conspicuous sudoriparous glands characteristic of the sternal hillock. × 6.5.

FIG. 3. Higher magnification of the sternal invagination of the orang, showing the dilated fundus, containing secretion and debris, surrounded by numerous, partially cystic sebaceous glands. The curved black line, connecting with the bottom of the invagination, is the neck of a sudoriparous gland which enters the invagination at this point. × 15.

FIG. 4. Higher magnification of the sternal hillock of the spider monkey, showing the numerous small hair follicles near the surface and the conspicuous sudoriparous glands beneath. Of the latter many are dilated. In the deeper portion of the corium, near the right of the figure, several compact masses of the branched sudoriparous glands, described in the text, can be seen. × 15.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THE JACK AND SNOWSHOE RABBITS AS SWIMMERS

By Charles Eugene Johnson

Aside from the marsh rabbit (*Sylvilagus palustris*) and the swamp rabbit (*S. aquaticus*), the aquatic habits of which are well known, the members of the Leporidæ are usually thought of as dry-land animals with no inclination to enter the water. There are, however, a few recorded instances where the jack rabbit (*Lepus townsendii*) and the showshoe rabbit (*Lepus americanus*) have been known to enter water and actually swim. In the few specific instances which I have found described where the swimming had been witnessed, it appears that with the exception of one case the hares had been "cornered" or hard pressed and had plunged into the water as a last resort. In the one exceptional instance the swimming had apparently been voluntarily undertaken. All the records referred to date back a good many years, and it may be well to review them briefly before giving an account of two instances of swimming hares witnessed by me personally, and which differ from the published accounts in that, in one case, while the hare was being pursued it was in no sense "cornered" or obliged to enter the water to escape capture; in the second case the swim not only was one of considerable length, but from all appearances was entirely a voluntary undertaking.

With reference to the jack rabbit, Seton (Life histories of northern animals, vol. 2, pp. 636–640) states that in the Yakima Valley of Washington he had been told "that the Whitetailed Jack never hesitated to plunge into any water that barred its path if too broad to be overleaped. It always manages, however, to shorten the swim considerably by leaping as far as possible at the start." He then gives an account of an "aquatic exploit" of the whitetail which had been described to him by an eye-witness, Col. L. L. Hawkins, of Oregon. The incident took place in the fall of 1880 on the Snake River, 60 miles above its junction with the Columbia. The Colonel and his men were on an island about 500 yards long by 150 yards wide. When they landed on this island "they saw a big Whitetail Jack jump into cover, and all the men went after him." The description then runs thus: "They [the men] were fifteen in number, and forming a line across, soon drove him out into the open and narrow part. He raced to the far point, then back a couple of times. They came within 50 to 60 feet of him, and now they were nearly shoulder to shoulder, as here the point was only 20 yards wide. Seeing no other escape the Jack then ran to the left of the island raced straight across to gather speed, then on the right side at the exact water's edge

he leaped with all his power into the river—covering fully 20 feet in that jump—and struck out bravely for the shore, 100 yards away. He swam very high and fast, splashing with his fore-feet, his ears laid back, and although the river was deep, cold and swift, he crossed about as quickly as a dog would have done, and lost very little through drifting."

Among instances of swimming on the part of the snowshoe rabbit Seton (loc. cit.) mentions one that came within his own experience at Carberry, Manitoba, in November, 1886, where he discovered a rabbit frozen in the ice near the margin of a pond. He writes: "The marks in the opaque ice showed how it had leaped into the water from the south side, apparently to escape a fox, had plunged through the weeds, and swum across the open part. But the course grew crooked, showing that its strength was going, and at the north end, near the bank, I found its body frozen in the new ice.

"Its head and back were out of water and dry, its eyes were wide open, its legs spread as though striking out. The entire course it left in the ice was about 50 feet. Thus was the tragedy written out with fullest details in the new ice and snow of the earliest storm."

Merriam (Mammals of the Adirondack Region, 1884, pp. 309–311) mentions two instances reported to him, one by Nelson Harris, the other by William Brewster. The first occurred in northern Michigan where "a White Rabbit that had stumbled into camp and was "cornered" was seen to plunge "fearlessly into a swiftly flowing river and swim to the other side." The observation of Brewster was made at Lake Umbagog, Maine, in the summer of 1873. The rabbit was seen to swim the Cambridge River at a point where it was 100 feet wide and at least 8 or 10 feet deep. The rabbit "entered the water deliberately, but without apparent fear or hesitation, and was soon beyond its depth and striking out boldly for the opposite shore. A more ridiculous attempt at swimming can scarcely be imagined. He literally *hopped* through the water, using his hind legs, and kicking with such vigor that the whole forward part of his body was raised above the surface at each stroke. Between strokes he would sink back until sometimes only the tip of his nose was exposed. I fancy that an immense bull-frog, weighted after the manner of Mark Twain's 'Daniel Webster' would cut a somewhat similar figure.

"The method of progression was naturally fatiguing, and before the animal reached the opposite bank the strokes became feebler and the intervals between them longer, until I began to fear that the tired creature would be drowned. At length, however, he struck bottom, and,

leaping across a stretch of bare mud, disappeared in the woods." This rabbit had apparently been "impelled by some idle whim, merely such as the desire to try new pasturage, or, perhaps, to see what the world was like on the other side of the stream. However this may be, the case is doubtless exceptional, for *Lepus Americanus* ordinarily has as great an aversion to the water as any house cat."

Personal observations. The instances which I have to report are for the jack rabbit (*Lepus t. campanius*) and the snowshoe rabbit (*Lepus americanus phæonotus*) in Minnesota. Incidentally I may add that near Lawrence, Kansas, in the spring of 1922, I saw a cottontail (*Sylvilagus floridanus mearnsii*) voluntarily hop through water up to its sides in crossing a small creek; and tracks in the mud here showed that the same individual or others of his kind had crossed and recrossed the creek at this point a number of times previously. It is not improbable that the cottontail may also swim if placed in the same situations as those in which the other two species have been known to do so.

One day in the spring break-up, in the year 1900 as I recall it, I was hunting along the banks of a coulee about five miles northeast of Warren, northwestern Minnesota. Although there was still considerable snow on the north-facing slope and in other places where drifts had accumulated, the coulee was in its annual flood stage, a temporary river. At the particular point in question it was about fifty feet wide, with a current perhaps of about two miles an hour. The south bank was much higher and steeper than the north bank which sloped away gradually from the water's edge and was flanked by a large plowed field.

I was walking along the crest of the high south bank while my dog, which had crossed the coulee some distance above, was ranging far and wide over the plowed field. Presently he started a jack rabbit and, as was his habit, immediately gave chase. The point where the rabbit was started was about two hundred yards or more from the coulee, toward which the chase headed in a large sweeping curve. The dog, a beast of the size of a setter and of highly questionable pedigree although supposed to be of Newfoundland stock, as usual very soon lost distance, so that when the rabbit approached the coulee he was trailing by many rods. Wondering what the rabbit might do when it reached the coulee, I stood still and looked on. To my astonishment the racing jack neither slackened its speed nor swerved in its course to right or left. It had unlimited territory to either side and had such a lead on the dog that it could easily have chosen a different way. But it ran straight to the water's edge, plunged in without the slightest hesitation, and swam to

the other side. Here it did not stop to shake the water from its fur, but bounded up the snow-covered bank and sped on in the same general direction. The dog in frantic pursuit also swam the coulee and pressed gamely on, but the distance between the pursuer and the pursued rapidly increased and in due time the dog returned, discouraged and dejected as on countless previous occasions when he had undertaken to match speed with the jack rabbit.

My own distance from the jack rabbit when it swam the coulee was about seventy-five to a hundred yards. Since I was on the high bank I had an unobstructed view, but the distance was too great to enable me to see anything but the general form of the body, with ears laid back, and that the animal was pushing itself forward through the water with vigorous jerky kicks and all of its back above the surface. Its course was slightly oblique against the current and it was my impression at the time that the rabbit crossed the coulee in less time than the dog. It was still in its white coat.

In reflecting upon this incident I came to the conclusion that the rabbit in crossing the coulee was perhaps merely following a route which it had been in the habit of taking during the winter, previously to the break-up, and in its frightened state now blindly held to the familiar course.

In regard to the snowshoe rabbit, this incident occurred in northern Lake County, August 9, 1922. My wife and I were encamped at the north end of the portage from the Kawishiwi River into Koma Lake. At the foot of the rapids at this point the river expands into a large bay which then narrows again as the river continues northward. While sitting near the camp fire writing up some notes for the day, and occasionally casting an eye over the water and around the shores, my attention was attracted to what I took at the moment to be a muskrat which swam out from the east shore of the bay, at the narrows above mentioned. The water was like a mirror and the low sun illuminated the whole of the east shore and a large part of the bay. A few moments later as I again looked up something about its manner of swimming, which clearly was not that of a muskrat, caused me to reach for the binoculars and examine the animal more closely. Even with the binoculars I could not definitely make out what the swimmer was, except that it was neither muskrat, beaver, nor woodchuck. As it was coming diagonally nearer I sat still and waited, deeply puzzled, now and then observing it through the glasses.

When about half way across the bay it entered the long shadows cast

by the woods on the west shore. Then I suddenly discovered that the swimmer was a snowshoe rabbit! This was an unusual sight and it now absorbed the attention of both of us. The course taken by the rabbit was diagonally toward our position from the point where it entered the water, and the nearest point at which it crossed our front was probably about a hundred and fifty feet from where we were sitting. The total distance it swam was according to my estimate about a hundred and fifty yards. The surprising thing to me was the easy and unlabored manner in which it swam. As in the case of the jack rabbit the ears were laid flat against the neck and shoulders. The rump was on a level with the head, giving the animal a distinctive appearance in side view. The fur on the upper parts was entirely dry, so that there had evidently been no plunge into the water at the outset, a thing which might have been expected had the rabbit been driven into the water in a desperate attempt to escape some enemy. The propelling organs clearly were the hind legs, and progression was by a series of vigorous, regular, and unhurried kicks. I could see nothing to indicate that the front feet were being used. It is possible that they were used in some manner, but surely not by lifting them and pawing in such a way as to impart any clearly evident bobbing motion to the anterior part of the body. The rabbit landed on an open stretch of beach and leisurely hopped into the woods without stopping to shake the water from its fur.

Another point of interest in this instance was that the rabbit did not choose the shortest course to the opposite shore, which was directly across the river at the narrows from the point where it started, but chose instead what was the longest way possible in the circumstances.

From all appearances this rabbit entered the water of its own accord. When I first saw it, only a few yards from shore, its movements in no way indicated an animal being pursued and no other disturbance was noted either on the surrounding surface of the water or in the bushes and grass that lined the shore.

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THE CARE OF BOOKS, PAMPHLETS, AND BIBLIOGRAPHIES

By L. R. Dice

A scientific library in order to render its fullest service must be so arranged that a desired publication can be found with the least effort. A catalog record of the library is nearly indispensable and cross references are desirable. Further, the books and pamphlets in the library must be protected as much as possible from the ravages of time and use.

BOOKS

Books differ from pamphlets only in the matter of thickness. Ordinarily, articles consisting of 150 pages or more are treated as books and are best preserved bound in cloth or leather. However, articles printed on thin paper and containing as high as 200 pages may sometimes be treated as pamphlets; on the other hand, it may be worth while to bind very valuable articles even though they consist of only a few pages. Paper binding for books is a temporary expedient, often necessary, but one which exposes a much used book to the risk of damage.

Protection of books. Books should be protected from extremes of moisture or dryness. Dampness is especially dangerous. Strong sunlight is injurious, but a moderate amount of light possibly helps to prevent the growth of mold and injurious animal life. Unless the library is exceptionally well protected against the entrance of dust, open shelves tend to allow dirt to soil the books. In ordinary buildings glass-fronted bookcases appear to offer the best protection to the library.

Arrangement of books. The best arrangement of books in a scientific library I consider to be alphabetical according to author's name, and under each author chronological as to date of publication. Quartos, folios, and odd-shaped books will of course have to be shelved in separate series from books of octavo or smaller sizes. Also, bound volumes of periodicals form a special group in the library.

PAMPHLETS

Reprints, excerpts, separates, and other small papers usually constitute the most valuable part of a working scientific library and therefore deserve especial care. They are always a problem to the librarian, and many different methods have been used for their grouping and

protection. These methods range from the heap of loose papers on a shelf to complicated systems requiring the services of a staff of assistants.

Arrangement of pamphlets. Four principal methods of grouping small scientific papers for storage have been employed. An easy and widely used method is to group the papers by subject matter, using for example such divisions as anatomy, geographic distribution, or North America. By this method all the available papers on one general topic are placed together. In a large collection it becomes necessary to establish subdivisions or to arrange the papers in the larger divisions alphabetically according to author.

The great difficulty in grouping pamphlets by subjects lies in classifying certain papers which might almost equally well be placed under any one of several divisions employed. Cross references then becomes necessary. Eventually the method becomes cumbersome and it is impracticable for a large pamphlet collection.

Another method of arranging a pamphlet collection is serial in the order of receipt. Each pamphlet when it is cataloged is given a serial number, which determines its position on the shelf. This method necessitates reference catalogs arranged according to author or subject, or both, and it is necessary to refer to the catalogs to find any paper in the collection because only a few of the serial numbers can be remembered.

A third method is to group the excerpts and separates from each periodical together, arranging them under volume and page numbers. Thus, all the mammal papers from the *Proceedings of the Biological Society of Washington* might be arranged together. There are of course a considerable number of pamphlets to which this method would not apply.

The arrangement which I consider best for all large pamphlet collections, and most small ones, is alphabetical according to the name of the author and chronological by date of publication under each author. If there are several papers by the same author published in the same year, they are best placed alphabetically by title. One is quite likely to remember the name of the author of any paper which it is desired to consult, and often the year of publication as well, so that usually a pamphlet can be found in the collection without recourse to a card catalog. Further, citations in scientific papers are usually by author and date, so that in many cases the paper referred to can be found directly.

I would except from this arrangement according to authors the papers from those periodicals of which complete volumes are available. If a volume of a periodical can be completed I think it best to keep it as a bound volume, even though this method disturbs somewhat the general order of pamphlet arrangement. However, I do not consider that it is desirable to bind incomplete volumes even though all the papers on any one topic, as for example mammals, may be at hand. I especially deplore the practice of those narrow specialists who break up complete volumes and discard all the papers except those on one topic. Many of these volumes, if kept complete, would be of very high value in the future; and in most cases it would not be much more difficult to store the complete volume than the excerpts alone.

Preservation of pamphlets. Much-handled pamphlets rapidly deteriorate unless given protection. This is especially true of the smaller and thinner papers, which become dog-eared and wrinkled, and pages and plates tend to work loose and may become lost or misplaced.

The best protection for printed pages undoubtedly is binding in standard library style, preferably in cloth or leather. The expense of binding, unfortunately, is considerable and one can not usually afford to bind small papers. However, a number of small papers grouped together may be bound in a volume and many collections of pamphlets have been treated in this manner.

The objection to collections of bound pamphlets lies in the impossibility of inserting in their proper places papers secured after the collection is bound. It is possible, of course, to make up volumes rather arbitrarily from time to time and to keep a general grouping by authors or subjects but such a method demands dependence on the card catalog to find any particular paper.

For protecting pamphlets against dust and light a simple method is to keep them in stout manila envelopes. The envelopes are then grouped by subject or author. A similar but better method is to store the papers in pamphlet boxes. These boxes may be made of strips of wood forming the top, bottom and front, with heavy cardboard on the sides, and the backs left open. A better construction is to have the boxes made entirely of a good weight of strawboard, faced on the inside with white paper and covered on the outside with black binder's cloth. These boxes are placed upright on shelves, the open backs being pushed against the wall to exclude dust and light. In such boxes very thin papers have a tendency to become folded or broken on the corners, and it is advisable to provide each pamphlet with a

cover of heavy paper. Sometimes pamphlet boxes are made with the tops open as well as the backs; this allows for larger pamphlets, but dust and light may enter. Also, occasionally, common letter files are used to store pamphlets, but their expense and their inconvenience render them unsatisfactory.

Pamphlets, either unbound or in binders, may be arranged upright on ordinary shelves like books, but it is not advisable to place them among books owing to the danger of damaging adjacent thin pamphlets when a book is removed. If pamphlets are kept in this way the shelves should be short, preferably less than two feet in length, and some space should be allowed so that the pamphlets can be separated sufficiently for one to be able to read the label written on the upper outer corner of each pamphlet. Pamphlets kept in this manner wear rapidly unless protected by strong covers of heavy paper or cardboard; nevertheless this is one of the least expensive methods of keeping them, and many collections are so kept.

Much protection can be given the papers in a collection by providing each with a cover of heavy paper. The cover can be trimmed on a print trimmer, and stapled on with the aid of a regular stapling machine. Considerably greater protection is given by the use of a cardboard cover, connected together on the back by a strip of cloth. Such a cover can be attached by stapling through the cloth and the pamphlet, or it can be attached to a gummed strip of cloth sewed to the back. Ready-made binders can be purchased from manufacturers of library supplies. The cost of these depends upon the size; those measuring 7 by 10 inches now cost about $6.25 per hundred. With these binders it is only necessary to wet the gummed strip and insert the trimmed and stapled pamphlet. The author's name, date of publication, and a catch title are written on a gummed label, which is attached outside on a corner of the cover, to facilitate ready finding. Ordinarily only one paper is put into each pamphlet binder. However, I often bind together a number of small papers which have been published by an author in a given year in the same periodical.

The advantages of pamphlet binders are the excellent protection given the papers, moderate cost, ease of arrangement according to authors or subjects, and the possibility of making additions to the collection at any time. Further, the pamphlet in its light-weight cover is handy and the use of one publication does not involve wear on other papers nor the removal of them from the collection, as is the case with bound volumes. A disadvantage of pamphlet binders is that the pages are

usually stapled through the backs, and they therefore do not open as flat as bound volumes.

The best storage place for pamphlets in cardboard binders is in filing cabinets. The invoice size of inexpensive filing cabinet that I use takes binders 7 by 10 inches. This size will take all octavo and smaller pamphlets, and even some larger sizes, including excerpts from *Science*. Filing cabinets cost little if any more than book cases of similar capacity and occupy considerably less wall space. They also better protect the pamphlets from light and dust, and make possible more rapid finding of any desired pamphlet. This method of caring for reprints has been developed at the Michigan Museum of Zoology and has given excellent satisfaction for a number of years. For quarto and larger pamphlets I use two large sizes of binders: 9 by 12 inches, and 10½ by 13 inches, respectively. The 9 by 12 size will go into a letter-size filing cabinet, but the larger size must be kept on shelves or in special cabinets.

Although unbound pamphlets are sometimes kept in filing cabinets I do not consider this method desirable, owing to the tendency of the papers to slump down. Pages and plates are often considerably damaged on the corners and edges, and there is also difficulty in removing or replacing pamphlets without damage to adjacent ones. This difficulty is not entirely avoided by the use of heavy paper covers nor by placing the papers in individual letter folders.

The method adopted for keeping pamphlets must depend on the use to be made of them and the time and money available for their care. The private collection must be adapted to the needs of the investigator concerned. However, in the much used library of a museum or a university department, I am convinced that a pamphlet collection gives its greatest service when the pamphlets are bound in cardboard covers and stored in filing cabinets.

BIBLIOGRAPHIES

Library catalogs. It is very desirable to have a catalog of the library. This enables one to determine quickly whether or not a given paper or book is in the collection. It also gives a chance to indicate the position of papers, such as quartos and folios, which are shelved in special places. The main library catalog may include any available cards of other titles on the subjects in which the owner is interested, even though the papers referred to are not now in the collection. The catalog thus serves as a general author catalog in the special fields of

interest. On the card referring to each paper which I own, my initials are marked on the lower left corner, and special marks indicate any over-sized or bound papers not with the main body of pamphlets.

It is highly desirable that the cards in the library catalog be made out in standard bibliographic form. The commonly adopted method is to place the author's name at the top; next, beginning a new line, the date of publication, followed by the exact title in full; and last, the complete citation, including the name of the periodical, volume number, inclusive pagination, number of plates, and number of text figures. It is also desirable that the cards used be 7.5 by 12.5 centimeters in size rather than 3 by 5 inches. This will allow the addition to the catalog of cards obtained from the Library of Congress, Concilium Bibliographicum, and other standard bibliographic sources. The two sizes of cards will not work satisfactorily in the same catalog. It seems unnecessary to emphasize the importance of using the best grade of cards and ink. Library Bureau cards no. 33210, blank, without punching are thoroughly satisfactory, and so is Higgin's Eternal ink. Punched holes for locking cards in the trays are not usually necessary except in catalogs open to the public. Typewritten or printed cards are more easily and quickly read in a catalog and therefore are preferable. Black record typewriter ribbons only should be used for typing bibliographic cards.

Bibliographic catalogs of small size can be kept in small wooden boxes or in the fiber containers made for this purpose by the manufacturers of library supplies; in the top drawer of a desk is also a good place, but the catalog should be placed across the drawer, rather than lengthwise. For larger catalogs a standard filing cabinet equipped with trays for 3 by 5 cards is best. The trays should not be more than about 14 inches long, and it is a great convenience to have each tray separately removable, so that it can be used on a desk. Sectional filing cabinets are very desirable because they allow expansion when necessary.

Secondary bibliographies may be necessary for the special subjects in which one is interested. For instance, bibliographies may be kept of titles dealing with the mammals of one state or with the species of one order, or bearing on a special topic. In such bibliographies, subdivisions may be made where desired, but I think it best to arrange the cards in each subdivision according to authors' names.

Secondary bibliographies are best carried on cards made out in exactly the same style as those in the main catalog, so that the cards

are interchangeable. The backs of these cards may be used for a brief abstract of the paper, and there is no objection to the use of additional cards for longer abstracts. It is well to indicate on the card the year when the abstract was made. Writing on the backs of cards is best placed upside down from that on the face; to read the back, the card can then be turned while held in one hand.

As time goes on one accumulates a considerable number of duplicate cards, some of which may not be quite complete as to data. Instead of throwing these cards away I use them to form incomplete bibliographies of various kinds, such as by orders of mammals or by countries or states. Such partial bibliographies, which I do not attempt to complete, at times render service in the search for particular references.

It is not desirable, as a rule, to carry too many bibliographies, nor to cross reference completely all the papers in one's library. The effort involved is too great, and there can be little hope of attaining completeness except in narrow fields. The preparation of complete or nearly complete bibliographies on special topics is, however, very desirable, and the publication of such bibliographies is of great service to science.

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THE FIRST LIVING ELEPHANT IN AMERICA

By G. G. Goodwin

[*Plates 23–25*]

Some weeks ago application was made to me for information on the first living elephant that came to the United States. Though the arrival of this elephant attracted much attention at the time, very little seems to be known about it today. I have been able to secure some interesting data on the subject and believe that these facts are of sufficient importance to be put on record.

The late John Robinson of the Peabody Museum, Salem, Massachusetts, favored me with a considerable amount of assistance in securing this information. Also Mr. George G. Putnam, dean of the newspaper men in Salem, has given freely of his knowledge of the subject.

The Log Book (now in the Essex Institute) of the ship "America" fixes the date of the landing of the first elephant as April 13, 1796, at

New York. The title of the Log Book reads, "A Journal of the Passage from Bengal to America in the Ship America of Salem 1796.[1] Nathaniel Hathorne's Book Presented by his Esteemed Friend Mr. Robert Robbinet, October 25th, 1795," and below is written "CALCUTTA." The first page begins abruptly—"Calcutta towards America Tuesday December 3, 1795." Nothing of interest until Wednesday, Feb. 17, 1796 (at St. Helena). "This day begins with moderate breezes. . . . . Latter part employed in landing 23 sacks of coffee, ... Took on board several pumpkins and cabbages, some fresh fish for ship's use and greens for the elephant." Below is written in large letters, "ELEPHANT on Board."

They stopped at the island of Ascension February 24, 1796. The men picked up several turtles, took some sharks and saw a large sea lion. The last page in the Log reads:

"Remarks Sunday April 10, 1796.

This 24 hours began with calm and cloudy weather . . . . at 3 p.m. Sandy Hook was N. W. by W. of us, distance 10 leagues. . . . ." Soundings are here recorded as taken hourly from 8 p.m. that evening until 3 a.m. the next morning, which would be April 11. "5 p.m. hove about and stood to the Northward. . . . . Saw the high land of Never Sink bearing N. W. of us, distance of 6 leagues. . . . . At 7 p.m. saw the Long Island bearing N. E. to N. W. by N."

The ship was six leagues from Never Sink on April 11 and it would take two days to get into port. The elephant was in all probability landed in New York, April 13, 1796. The voyage was a remarkably calm one, and except for a few squalls no storms were recorded.

The next record of importance concerning the elephant is an extract from a New York newspaper dated April 1796. "The Ship America, Capt. Jacob Crowninshield of Salem, Mass., Commander and owner, has brought home an elephant from Bengal in perfect health. It is the first ever seen in America and is a great curiosity. It is a female two years old."

Different writers in their reminiscences of early times fail to agree in the account of the landing of the first elephant on American soil, and the date of its advent is placed all the way from 1776 to 1833.

[1] Careful comparison shows that the Log Book is written in Nathaniel Hathorne's own handwriting. He must have been an officer on the ship. This is the father of Nathaniel Hawthorne, the author, who later added the w to the family name.

Most of the confusion seems to have arisen from the fact that there have been many ships named America. Of four in succession, two were owned by Elias H. Derby, and two by the firm of George Crowninshield and Sons of Salem. The first of these ships of that name was a prize named "Pompey," captured during the Revolutionary War in 1783 by the ship Grand Turk of Salem. She was rechristened America. Bills of the Derby business ventures show that she was sent on a voyage to Europe for three months and returned from England, April 1784. She was sold at New York for 1600 pounds sterling in the fall of the same year. The second ship America was a French vessel bought for Elias Hasket Derby at the Isle of France by Jacob Crowninshield in 1794. She was insured in March 1795 and taken over by Jacob and Benjamen Crowninshield, who immediately made a trip to Calcutta. She returned to New York April 13, 1796, and was probably sold in the early summer. In her, the Salem ship register states, was brought the first elephant, April, 1797. The third ship America was formerly named "Blonde." She was bought in Bordeaux by Capt. Benjamen Crowninshield and arrived in Salem in 1798, and was 754 tons—the largest merchant vessel owned in the United States at that time. The fourth ship America was the most famous of Crowninshield's ships and could outsail anything afloat. She was built by the owners for the East Indian trade and in 1804 she made her first voyage.

There were five Crowninshield brothers, all in command of ships in trade with India at about the time when the first elephant was on its way to America. Jacob Crowninshield was captain of the "America," Benjamen Crowninshield of the "Henry," Richard Crowninshield of the "Minerva," and George and John Crowninshield of the "Belisarius." An extraordinary occurrence of two captains in charge of the same boat is proved by the letter of instruction and sailing order which reads, "To Captains George Jr. and John Crowninshield of the ship Belisarius 1795. You and each of you have charge of the ship Belisarius and her cargo, as per invoice. . . . . "

John C. Crowninshield, nephew of Jacob Crowninshield who brought the first elephant to this country, was devoted to family traditions and history. He had many papers and other matters relating to the Crowninshield family in his possession. In an autograph letter from John C. Crowninshield to Mr. G. Putnam, dated December 24, 1895, he says, "The first elephant was brought to this country by my father's brother Jacob, then in command of the ship America owned by George Crowninshield & Sons, in 1796, which would be 100 years since. The story in

the Herald is something I never heard of; it fixes the time at 1814, which of course would not make it the first elephant in this country. I send you the account which can be relied on as the historic fact. . . . . I have taken the account from letters written at the time. . . . . I have heard from the family that it made the tour of the southern states and was afterwards exhibited in the eastern states."

Mr. G. G. Putnam, in a carefully prepared article on the first elephant in the Salem Daily Gazette, 1895, quotes from an account by J. C. Crowninshield on the subject in the Andover Townsman. It reads: "From a pile of old letters, sea journals, log-books and charts that have lain securely ensconced in an old sea chest for more than one hundred years, facts and old time commercial incidents can be gathered of much historic interest. . . . . An extract or two from letters dated in India fix the time concerning the first elephant. Jacob Crowninshield, writing to his brothers John and George, both in command of the ship Belisarius and on their way to India, Nov. 2, 1795, says, we take home a fine young elephant, two years old, at $450.00. It is almost as large as a very large Ox and I dare say we shall get it home safe, if so it will bring at least $5,000.00. We shall at first be obliged to keep it in the Southern States till it becomes hardened to the climate. I suppose you will laugh at the scheme but I do not mind that. Will turn elephant driver. We have plenty of water to the Cape or St. Helena. This is my plan. Ben. did not come into it, so if it succeeds I ought to have the whole credit and honor too. Of course you know it will be a great thing to carry the first elephant to America." On November 26, but a few days later, in another letter he says, "The elephant is on board and quiet. I suppose I shall have to stop at Mauritius for water, or the Cape or St. Helena though we have 3,500 gallons."

Both John C. Crowninshield and G. G. Putnam, in their articles on the first elephant in America, have the date of the arrival fixed for 1796, and seem convinced that it came on the second ship "America" which is also the one indicated by B. B. Crowninshield in his account of the "Private Armed Ship America." He calls the second "America" the elephant ship but claims that it did not arrive here until 1797. The Log-book and the shipping notice in the New York paper, however, clearly show that the elephant arrived at New York, April 13, 1796.

A brief summary of the travels and exhibits of this elephant can be traced through newspapers and other reports. The first notice is in "The Argus or Green Leaf Daily Advertiser" which on April 23, 1796, and in many succeeding editions, advertised the first elephant as being

on exhibition in New York at the corner of Beaver Street and Broadway. The next record is from a handbill that Mr. John Robinson had in his possession for some time advertisting the exhibition of the elephant in Boston. It is dated August 1797, and was sent to the World's Fair with an accompanying note explaining it. Then, on September 5, 1797, the Salem Gazette states that "the elephant will leave town in two days and go to Marblehead for three days." On September 12, it states that the elephant will be exhibited in Beverly at the new house opposite Captain Goodridge's. The elephant appears to have been taken south to become acclimated, and was apparently brought north again by boat to Philadelphia in April 1789, according to the harbor reports there. Mr. E. Savage, one of America's earliest showmen, advertised the exhibition of the elephant in Boston, June 25, 1804, and on July 3 it is again in Salem and on view at the Sun Tavern. Mr. J. W. Shelley, of the New York Dispatch, in letters to Mr. G. G. Putnam, says that he has been tracing the travels of the first elephant and got as far as Baltimore. The Maryland Historical Society found the granting of the license and also one granted in New York.

"Old Bet" seems to have been the name that was applied to this elephant, though J. C. Crowninshield claimed that it was the name given to the elephant brought by Hackaliah Bailey's brother in 1814. The story goes that Bailey's brother, a sea captain, purchased the elephant while making a world tour. However, this was probably Crowninshield's elephant. In the Salem Gazette, January 2, 1896, there is a quotation from a letter written by J. C. Crowninshield, which reads: "I wrote to Somers, N. Y., and had a letter from Charles E. Culver of that place. He says there is a monument built of stone, surmounted by an image of an elephant, in front of the ELEPHANT Hotel, which building was erected by Hackaliah Bailey, 1823–4, owner of Old Bet and father of the show business. He has no brother and probably made the purchase of your kinsman." The monument appears to have been erected about 1827 by Hackaliah Bailey when he returned from one of his circus tours. The image is carved in wood and was originally gilded. It stands on a shaft of dressed granite. The monument is standing in Somers today and is kept in good repair, though the gilt has long since disappeared.

Available accounts of the death of Old Bet fail to establish any definite proof of the date and reports are conflicting.

The diarist, William Bently, refers to the killing of the "poor elephant" by a crank in Maine who felt that the animal was taking money

from the poor. A writer in the Boston Herald, December 22, 1895, states that Old Bet was killed in North Carolina in 1827. An article by C. F. Crosby in the Boston Herald, December 30, 1895, states that: A catalogue of Barnum's American Museum in New York where Old Bet's remains were viewed by hundreds of thousands of people, states that she was maliciously killed in Rhode Island, in 1816. Taken from the catalogue, the killing is described as follows: "A boy was induced to secret himself as she passed on the road and test the story that her hide was bullet proof. He did so, the shot hit her in the eye and instantly killed her." The above story seems to be somewhat discredited by the fact that in 1816 the American Museum was owned by J. Scudder and it was not until 1841 that P. T. Barnum purchased it. Lists of animals, both in the American Museum and in the Lyceum of Natural History (Blunt's Strangers Guide to New York) in 1817, do not mention an elephant on exhibition, though animals of much less importance are listed.

In a clipping from the Salem Gazette marked 1895, there is an article which states that: After the first elephant was killed at Rhode Island, a second was imported, which was also named Old Bet. The show was enlarged by adding a lion in a two horse cage and a monkey in a box strapped to the end of the cage. A story in the Chicago Inter-Ocean, October 1895, states that the second Old Bet was landed in 1833, and following her to these shores the next pachyderm to arrive here seems to have been Mogul, a very big fellow with long tusks. This elephant was burned on the steamer Royal Tar between St. John's, Newfoundland, and Portland, Maine.

THE FIRST AFRICAN ELEPHANT IN AMERICA

In the Chicago Times Herald, February 21, 1897, there is a long article about the elephant "Janette," which the showmen, it states, "believe to be the oldest elephant in the United States and the first brought to America." It goes on to say that she died at Peru, Indiana, when she was 116 years old, having been a tenant of menageries in this country since 1824. She was an African elephant, the article states, with enormous ears of the umbrella kind, was obtained by an agent in England from a lot of animals just arrived from the Cape of Good Hope. She came in a "clipper from Liverpool" (clipper ship in 1823 is a little advance of 1848–1850!!), she cost 5000 pounds and was exhibited not far from Battery Park, New York City.

SOME EARLY RECORDS OF FOREIGN ANIMALS IN AMERICA

In the Annals of Salem, 1849, there is a list of events in that city by J. B. Felt in which he says that there was an elephant on exhibition at the new market house in September 1797, and at Mr. Tauzan's hotel there was on view a bison from Arabia; that in 1816 there were in Salem an elephant, a royal tiger, and other wild animals, and in 1795 an African lion. In 1789, he reports in Salem two camels from Arabia, male and female, and in 1820, a buffalo of great size. He also reports a caravan in Salem, July 1820, with a lion, lama, ocelot, ichneumon, etc. In 1831 he records an orang utan and the last entry worthy of note here is "Immense flocks of wild pigeons in Salem, 1822." The date of the camels is verified from a notice in the "Salem Mercury" for August 4, 1789, headed, "To the Curious, to be seen at Mr. Benjamin Daland's, near the town pump, Salem, Two Camels, male and female, imported from Arabia."

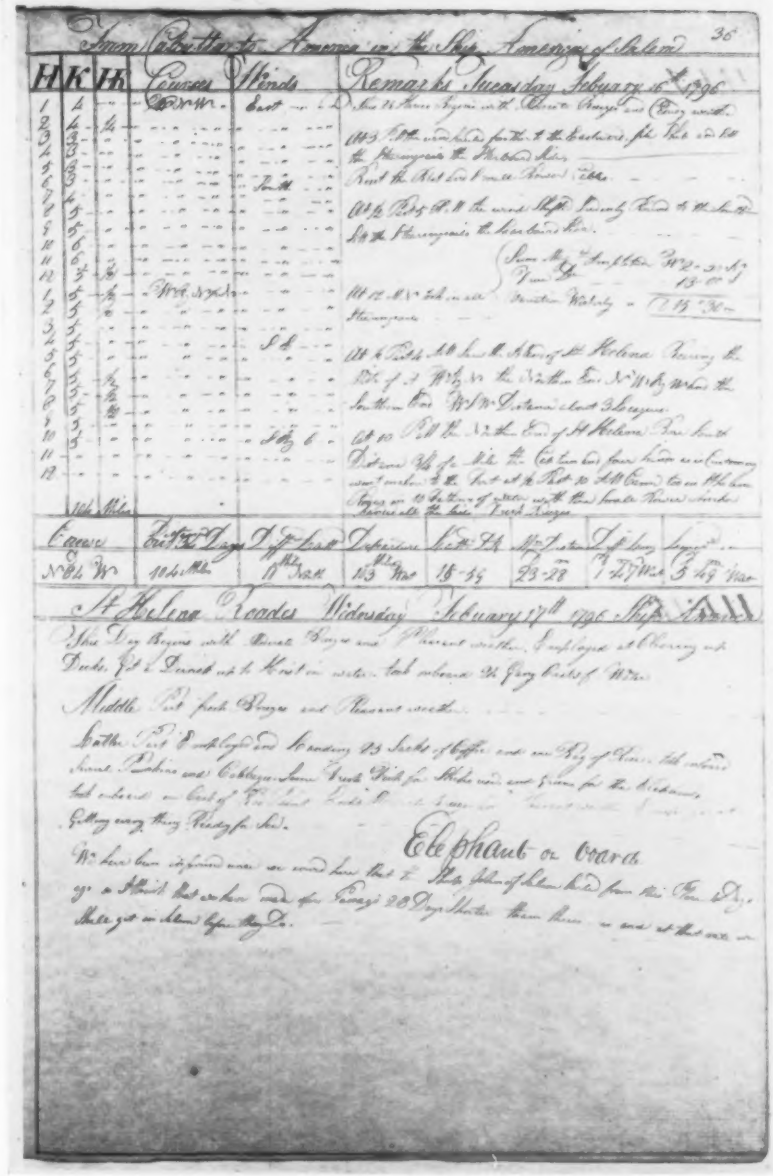
CAMELS IMPORTED FOR TRANSPORTATION OF ARMY SUPPLIES

In 1855 Congress appropriated $30,000 for Jefferson Davis to experiment in importing camels and dromedaries for transporting army supplies. Lieut. David D. Porter and Major Henry Constantine Wayne were assigned to secure the animals; and, on February 15, 1856, they sailed from Smyrna, Asia Minor, with 33 camels and arrived at Indianola, Texas, on May 13, 1856. A second shipment of 41 camels was landed by Lieut. Porter at Indianola on February 10, 1857.

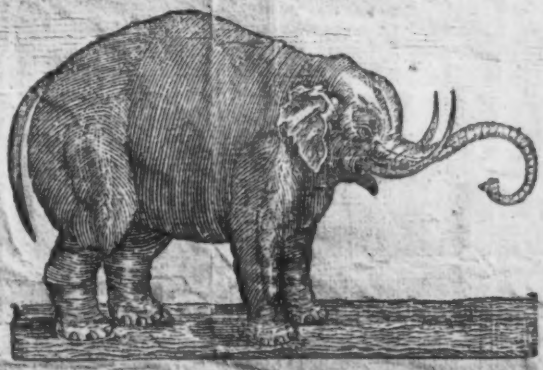
When war broke out the Confederate authorities turned them loose and eventually the herd was exterminated.

In 1858 a British vessel brought over two cargos of camels for a Mrs. Watson of Houston, Texas, and in 1861 a San Francisco company imported 20 Bactrian camels.

An article in the Popular Science Monthly (Feb., 1909, p. 142), states that "In 1701 some camels were brought to Virginia, but nothing more is known of them. In Jamaica, where the English tried them . . . . an insect got into the feet of the camels, rendering them unserviceable." This article also claims that "The Spaniards had imported them into Cuba and South America for use in transporting ore from the mines to the coast."



A PAGE FROM THE LOG-BOOK OF THE SHIP "AMERICA" WITH THE RECORD OF THE ELEPHANT ON BOARD AT ST. HELENA, FEBRUARY 17, 1796



THE

Elephant,

ACCORDING to the account of the celebrated BUFFON, is the moſt reſpectable Animal in the world. In ſize he ſurpaſſes all other terreſtrial creatures; and by his intelligence, he makes as near an approach to man, as matter can approach ſpirit. A ſufficient proof that there is not too much ſaid of the knowledge of this animal is, that the Proprietor having been abſent ſix ten weeks, the moment he arrived at the door of his apartment, and ſpoke to the keeper, the animal's knowledge was beyond any doubt confirmed by the cries he uttered forth, till his Friend came within reach of his trunk, with which he enfolded him, to the aſtoniſhment of all thoſe who ſaw him. This moſt curious and ſurpriſing animal is juſt arrived in this town, from Philadelphia, where he will ſtay but a few weeks.——————————— He is only four years old, and weighs about 3600 weight, but will not have come to his full growth till he ſhall be between 30 and 40 years old. He meaſures from the end of his trunk to the tip of his tail 15 feet 8 inches, round the body 10 feet 6 inches, round his head 7 feet 2 inches, round his leg, above the knee, 3 feet 3 inches, round his ankle 2 feet 2 inches. He eats 130 weight a day, and drinks all kinds of ſpiritous liquors; ſome days he has drank 30 bottles of porter, drawing the corks with his trunk. He is ſo tame that he travels looſe, and has never attempted to hurt any one. He appeared on the ſtage, at the New Theatre in Philadelphia, to the great ſatisfaction of a reſpectable audience.

A reſpectable and convenient place is fitted up at Mr. VALENTINE's, head of the Market, for the reception of thoſe ladies and gentlemen who may be pleaſed to view the greateſt natural curioſity ever preſented to the curious, and is to be ſeen from ſun-riſe, 'till ſun-down, every Day in the Week, Sundays excepted.

☞ The Elephant having deſtroyed many papers of conſequence, it is recommended to viſitors not to come near him with ſuch papers.

☞ Admittance, ONE QUARTER OF A DOLLAR.——Children, NINE PENCE.

Boſton, Auguſt 18th, 1797.

BOSTON: Printed by D. BOWEN, at the COLUMBIAN MUSEUM Preſs, head of the Mall.

HANDBILL OF AN ELEPHANT EXHIBITION IN POSTON, OCTOBER, 1797, NOW IN POSSESSION OF WILLIAM C. ENDICOTT, A GREAT GRANDSON OF JACOB CROWNINSHIELD

TO THE CURIOUS!

To be ſeen at

TWO CAMELS,

MALE and FEMALE, imported from *ARABIA.*

THESE ſtupendous Animals are moſt deſerving the attention of the curious, being the greateſt natural curioſity ever exhibited to the public on this continent. They are nineteen hands high; have necks near four feet long; have a large high bunch on their backs, and another under their breaſts, in the form of a pedeſtal, on which they ſupport themſelves when lying down; they have four joints in their hind legs, and will travel twelve or fourteen days without drinking, and carry a burthen of fifteen hundred weight; they are remarkably harmleſs and docile, and will lie down and riſe at command.

Abraham was old and well ſtricken in age: And the Lord had bleſſed Abraham in all things. And Abraham ſaid unto his eldeſt ſervant of his houſe, that ruled over all that he had, Thou ſhalt go unto my Country, and to my Kindred, and take a Wife unto my Son Iſaac. And the ſervant took ten Camels, of the Camels of his Maſter, and departed; and went to Meſopotamia, unto the city Nahor. And he made his Camels to kneel down without the city, by a well of water, at the time of the evening, even the time that Women go out to draw water. And Rebecca directed the ſervant, and proceeded him in obtaining the conſent of the Parents, Brethren and Kindred of Rebeccah, that ſhe ſhould go to the Land of Canaan, and become the Wife of Iſaac. And they ſent away Rebeccah their Siſter, with her Damſels and her nurſe, and Abraham's ſervant, and his men, and they rode upon the Camels ——(Gen. xxi.)

ADVERTISEMENT IN THE "SALEM MERCURY," AUGUST 4, 1789, OF TWO CAMELS FROM ARABIA

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American Museum of Natural History, New York, N. Y.

LONGEVITY OF MAMMALS IN THE PHILADELPHIA ZOOLOGICAL GARDEN

By C. Emerson Brown

Very little is known of the length of the lives of animals in the wild state, as there seems to be no very definite method of tabulating them. However, in most of the best zoological gardens there are records kept of all arrivals and deaths, and we are therefore enabled to give the exact period of an animal's life here under conditions that exist in captivity. On some of the arrivals we have data as to time of birth, others we can judge the birth dates very closely, while in some instances it is very difficult to ascertain just how old the animals are upon their arrival here. I do not believe, however, that any animal in the wild lives long enough to die of old age. Its enemies are numerous, the vicissitude of the weather, and the depredation of the hunters added to the killing of many by their own kind, it seems to me would not permit of any dying actually from old age. In the zoological gardens where every precaution is taken to prevent fighting, where no enemies can reach them, and where each individual is carefully taken care of under sanitary conditions and given plenty of the very best foods, they do live for many years and a number do actually die of diseases of blood, heart and kidneys, which are the diseases that are so common in human old age.

Anyone who has ever directed a zoological garden for any length of time, or who has in any way been connected with an institution where wild animals are reared or kept, is well aware of the constant attention that must be given the animals to keep them successfully in good health. He must devise means again and again to care for sick, feeble or newly-born specimens, and, as so very little information can be found on this subject in any publications, it is necessary to treat each individual case in a way that seems advisable for that particular animal at the time. Many specimens arrive in a feeble and unhealthy condition after a long hard journey, and especially is this true of specimens that have been brought in by amateur collectors. In cases of this kind, no time must be lost in ascertaining the correct diet and in getting the animal into clean and properly ventilated quarters. In spite of the very best efforts, however, a few specimens are lost during the period required for them to become acclimated and accustomed to their new environment.

I shall not attempt to give the length of life of all of the thousands of specimens on our records, but shall give only one or two records of each species that has lived for what I consider an exceptionally long period.

Both the echidna and white-handed gibbon, I believe, are records for the length of life of these animals in captivity. When no dates are given under "deaths" the animal is still living.

TABLE 1

NAME	RECEIVED	DIED	REMARKS
Primates			
Chimpanzee (*Pan niger*) ♀ "Mimi".....	5/24/1912	6/21/1923	Probable age when received 7 years
Chimpanzee (*Pan niger*) ♀ "Johanna"...	6/22/1912		Still living; probable age when received 5 years
White-handed gibbon (*Hylobates lar*) ♂..	7/26/1906		
Grivet monkey (*Cercopithecus sabaeus*)...	4/19/1908	2/13/1922	
Rhesus macaque (*Macacus rhesus*).....	10/24/1917	9/2/1924	
Japanese macaque (*Macacus fuscatus*)....	9/ 3/1915		
Lion-tailed macaque (*Macacus silenus*)...	9/19/1912	11/13/1920	
Barbary ape (*Macacus inuus*).....	6/18/1907		
Hamadryas baboon (*Papio hamadryas*) ♂	5/ 9/1910	7/26/1924	
Hamadryas baboon (*Papio hamadryas*) ♀	3/31/1914	1/ 7/1925	
Chacma baboon (*Papio porcarius*).....	1/15/1908		
Brown cebus (*Cebus fatuellus*).....	9/13/1917	10/ 1/1919	25 years old when received
Carnivora			
Lion (*Felis leo*).....	12/28/1874	5/18/1887	
Lion (*Felis leo*) ♀.....	6/12/1915	9/15/1924	
Leopard (*Felis pardus*).....	11/ 1/1913	1/ 7/1925	
Snow leopard (*Felis uncia*).....	2/26/1914	1/ 5/1922	
Puma (*Felis concolor*).....	10/24/1919	8/19/1924	
Spotted hyena (*Hyæna crocuta*).....	4/19/1907		
Spotted hyena (*Hyæna crocuta*).....	11/10/1874	1/30/1896	
Striped hyena (*Hyæna hyæna*).....	3/24/1914	1/14/1923	
Brown hyena (*Hyæna brunnea*).....	6/ 7/1888	1/27/1901	
Coyote (*Canis latrans*).....	5/28/1915	10/29/1924	
American gray wolf (*Canis mexicanus*)...	1/17/1911	10/31/1922	
European gray wolf (*Canis lupus*).....	3/31/1914	11/16/1922	
Ring-tailed bassaris (*Bassariscus astutus*)	5/13/1919	9/ 9/1924	
Ring-tailed bassaris (*Bassariscus astutus*)	4/26/1916	7/16/1924	
Malayan paradoxure (*Paradoxurus hermaphroditus*).....	12/20/1909	5/30/1922	
Beech marten (*Martes foina*).....	3/31/1914	8/ 9/1924	
Cape ratel (*Mellivora ratel*).....	6/28/1910	6/27/1922	
Brown bear (*Ursus arctos*).....	2/ 2/1912		

TABLE 1—*Continued*

NAME	RECEIVED	DIED	REMARKS
Carnivora—Continued			
Kamchatkan brown bear (*Ursus beringiana*)	9/27/1913		
Grizzly bear (*Ursus horribilis*)	6/15/1911		
Black bear (*Ursus americanus*)	11/17/1902	11/15/1922	
Black bear (*Ursus americanus*)	8/12/1905	2/25/1924	
Black bear (*Ursus americanus*)	7/17/1912	10/26/1924	
Rodentia			
Texas fox squirrel (*Sciurus ruſiventer limitis*)	3/18/1918	10/13/1924	
Malaccan porcupine (*Hystrix longicauda*)	10/ 3/1903	11/ 4/1921	
Proboscidea			
Indian elephant ♀ (*Elephas indicus*)	11/ 1/1876	7/ 8/1914	Name "Empress"
Indian elephant ♀ (*Elephas indicus*)	5/16/1902		Name "Lizzie"
Indian elephant ♂ (*Elephas indicus*)	12/25/1888	7/31/1908	Name "Boliver," weight 12,000 pounds
Ungulata			
Indian rhinoceros (*Rhinoceros unicornis*)	3/13/1875	1/ 3/1901	
Brazilian tapir (*Tapirus terrestris*)	10/ 1/1879	6/16/1899	
Prjevalsky's wild horse (*Equus prjevalskii*)	4/12/1913		
Persian wild ass (*Equus onager*)	5/ 1/1913		Born in garden
Persian wild ass (*Equus onager*)	5/27/ 902		Born in garden
American bison (*Bison bison*)	2/26/1912	12/ 6/1924	3 years old when received
American bison (*Bison bison*)	9/28/1910		Born in garden
Livingstone's eland (*Taurotragus oryx livingstonii*)	10/ 3/1906	9/18/1909	
Livingstone's eland (*Taurotragus oryx livingstonii*)	5/ 3/1917		
Leche antelope (*Cobus leche*)	9/ 1/1909	2/ 6/1920	
Indian antelope (*Antilope cervicapra*)	12/28/1915	7/11/1923	
White-tailed gnu (*Connochætes gnu*)	9/ 2/1881	12/ 2/1924	
White-bearded gnu (*Connochætes albojubatus*)	6/ 5/1908		
Himalayan tahr ♂ (*Hemitragus jemlaicus*)	8/11/1916		Born in garden

TABLE 1—*Concluded*

NAME	RECEIVED	DIED	REMARKS
Ungulata—Continued			
Aoudad ♂ (*Ovis tragelaphus*)	8/11/1915		Born in garden
Red deer ♂ (*Cervus elaphus*)	5/30/1904	6/14/1923	
Red deer ♀ (*Cervus elaphus*)	6/14/1912	10/22/1924	
White-tailed deer (*Odocoileus virginianus*)	6/14/1917	8/22/1924	
Llama (*Lama glama*)	2/ 4/1888	8/18/1906	
Llama (*Lama glama*)	11/30/1913	5/ 4/1924	
Common camel (*Camelus dromedarius*)	2/ 4/1875	12/20/1892	
Bactrian camel (*Camelus bactrianus*)	11/12/1914	2/25/1924	
Wild boar (*Sus scrofa*)	10/30/1909	3/ 3/1923	
Monotremata			
Common echidna (*Tachyglossus aculeatus*)	10/ 3/1903		Still living

Philadelphia Zoological Gardens.

THE TAIL AS A BALANCING ORGAN IN MICE[1]

By C. W. Buck, N. Tolman and W. Tolman

While we were conducting some laboratory experiments with mice we noticed that one mouse with a short tail was unable to keep its balance while running across a small rod. As we did not find any literature concerning the functions of the tail we decided to make a series of observations to determine the value of the tail as a balancing organ, following the suggestions of Prof. D. D. Whitney.

Box traps were set and a number of common house mice (*Mus musculus*) were caught. A special testing cage was built 36 inches long, 12 inches wide and 18 inches high. The sides were of glass and the ends of wire netting. A glass rod about 40 inches in length was run through the entire length of the cage in the middle near the top. This rod was wrapped with adhesive tape in order to provide a good footing for the mice. It was 5 mm. in diameter after being wrapped. Weights were so arranged on one end of the rod that whenever the rod was slightly turned it would come back to its original position again. An aluminum marker was attached to the other end of the rod which recorded the

[1] Studies from the Zoological Laboratory, The University of Nebraska, no. 148.

FIG. 1. OLD MICE

A, graph of a mouse with a normal tail making four trips across a movable rod, showing very little oscillation of the rod; *B*, graph of three trips across the rod of the same mouse several days after its tail had been removed showing extreme oscillations of the rod which indicates that it fell toward the left and toward the right and was unable to keep itself upright on the rod.

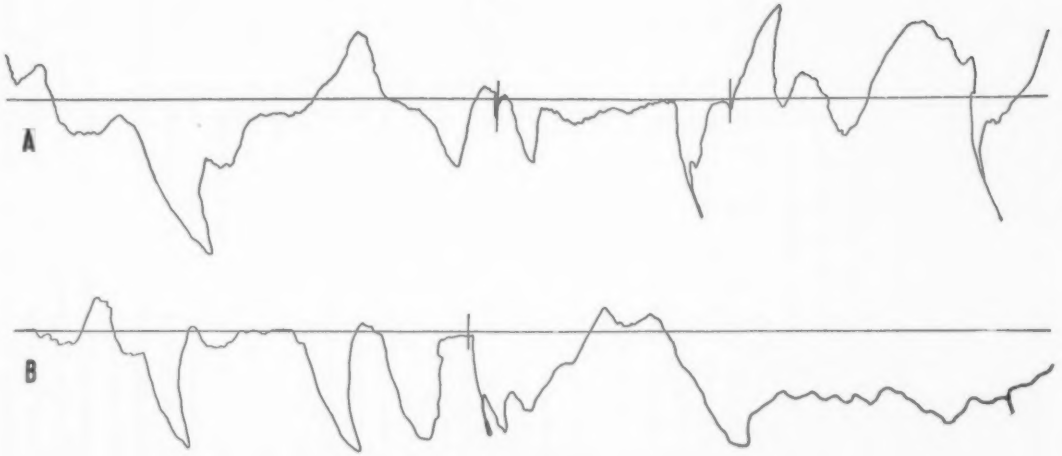

FIG. 2. YOUNG MICE

A, graph of a mouse with a normal tail making three trips across a movable rod, showing extreme oscillations of the rod as the mouse fell to either side, being unable to maintain its balance; *B*, graph of two trips across the rod of the same mouse several days after its tail had been removed, showing extreme oscillations of the rod to one side as the mouse repeatedly regained its upright position and fell over again.

amount of turning on a smoked drum of a kymograph as the mouse ran across the rod.

Twenty-five mature and seven half-grown mice were used in the experiments. Several graphs were made of each mouse with its normal tail as it ran across the rod. Then each mouse was etherized and its entire tail cut off. After the wound had thoroughly healed the tailless mouse was made to go across the rod again and several more graphs were made showing the movements of the rod.

The normal adult mouse waving its tail from side to side slowly or in some cases waving it rapidly usually crossed the rod without losing its balance. Sometimes it would cross slowly and at another time it would cross quickly. Occasionally it would stop midway on the rod, stand on its hind legs and smell of the roof of the cage as if in play. Once in a while, however, one would lose its balance in crossing and swing around to the under side of the rod. Wrapping its tail around the rod and using its claws it would easily and quickly regain its upright position upon the top of the rod and continue on its way across. Figure 1, A, shows a typical graph of a normal mouse crossing the rod with very little rotation of the rod occurring.

When the tail was removed the same mouse showed a different disposition in crossing the rod. It appeared timid in venturing upon the rod and either attempted to cross it very slowly and cautiously or dashed across it very rapidly seemingly trying to reach the other end before it had time to lose its balance. When it crossed the rod slowly it usually lost its balance quickly and then began violent bodily movements in an endeavor to regain its upright position. Many times it regained its upright position only to lose it again to the opposite side as is shown in Figure 1, B. Attempting to cross the rod in an upright position was really a strenuous undertaking. Sometimes the mouse would swing to the under side of the rod being utterly incapable of regaining its original upright position. In this position with its dorsal side downward it would travel across the rod. It required a considerable amount of coaxing and driving to get these tailless mice to start the trips across the rod and seemingly the more trips they made the more reluctant they appeared in attempting them.

The young mice which were reared in small cages reacted quite differently from the adult mice in crossing the rod before their tails were removed. They would begin the trip across the rod but would soon lose their balance although waving their tails frantically and showing strenuous bodily movements. Figure 2, A, shows a typical graph of

such a young mouse with a normal tail. Although they had tails they apparently had not learned how to use them and were as helpless in crossing the rod as though they were tailless. When the tails were removed the graphs of the same mice were almost identical with the graphs when they had their tails as is shown in Figure 2, B.

The adult mice probably had learned how to use their tails in balancing before they were trapped while the young mice never had had an opportunity of learning as they had been reared in small cages.

Summary.—The ordinary house mouse learns to use its tail as a balancing organ and may become very proficient in its use.

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NOTES ON SOME MAMMALS FROM ECUADOR

By Einar Lönnberg

Some time ago last year (1924) the Natural History Museum in Stockholm received from Consul L. Söderström in Quito a spotted cat, collected at Gualea on the western side of Pichincha, 4000 feet above the sea, May 10, 1921. At the first look I believed it to be an ocelot to judge from the pattern and the reversed hair of the neck. When the skull had been examined it proved, however, to be a member of the subgenus *Margay*. When Allen (1919) published his very valuable review of the "Smaller Spotted Cats of Tropical America" he referred to *Margay* five different forms divided between two species, namely, *tigrina* with three and *glaucula* with two subspecies. The former inhabit South America east of the Andes from southern Brazil to Venezuela and southern Colombia, while the latter appear to be known hitherto only from Central America. In addition to these Goldman has described from Panama a species, which he called *Felis pirrensis* and first (1914) referred to "the *pardinoides* group" (i.e. *Oncilla* Allen), but afterwards (1920) he was inclined to consider it a member of "The *wiedii* group" (i.e., *Margay*). There appears thus to be six known forms of *Margay*. The present specimen differs very much from the typical *wiedii* from southern Brazil in being less tawny or rufous. It has also much shorter fur and larger, more elongate, stripe-like markings, reminding one of the ocelots. From *vigens* described by Thomas (1904) from Para it differs in pattern and also by its wider braincase, but smaller bulla.

The mammals from the western side of the Andes in Ecuador often show more resemblance to Central American forms than to such from the eastern side of the Andes, and this may also be the case with this cat. Goldman's species *pirrensis* from Panama is, however, widely different with regard to its pelage, color and pattern, and it does not show any close affinity to this cat from eastern Ecuador. The Mexican *glaucula* Thomas (1903) differs with regard to the length of its fur and the color of the same, and it seems also to be smaller. More similar to our cat from Ecuador is Allen's subspecies of the last mentioned, which he named *nicaraguæ* (1919). As the following description will prove, there are, however, some differences, which together with the geographical isolation, permit the naming of a new subspecies:

Felis (Margay) glaucula ludovici subsp. nov.

Fur very smooth, but rather harsh when stroked against the direction of the hairs. The latter are rather short, measuring about 14 mm. on the back but only about 7 mm. on top of the neck. The fur is very smoothly reversed forwards from behind the withers and to the crown. The color of the dorsal area is rather dull, or somewhat greyish buff, gradually becoming paler and more greyish on the sides. The black markings are very sharply defined. The cheeks are white with two well developed black longitudinal stripes. Nape with four black stripes, which are well defined and to begin with of similar breadth, but behind the ears the middle pair increases in breadth to more than 1 cm., while the outer ones continue with about half that breadth and finally end somewhat in front of the shoulders, while the middle pair suddenly and with broadly rounded ends ceases above the withers. On the posterior part of the neck there is a double row of quite narrow linear spots mesially between the broad stripes of the middle pair. Just outside of the posterior ends of the latter there is on either side a broad irregular black ring with a central spot of the ground color. Behind this place the markings of the back consist of longitudinal, band-like spots, which soon become confluent to a continuous black mesial band to the root of the tail, and on either side of the same is another similar but partly broken band. On the sides of this dorsal pattern there are on the shoulders some irregular, partly vertical, black markings, but behind the shoulders the markings take the shape of obliquely longitudinal bands more or less broken up in long spots and containing central areas of the ground color (perhaps a little more greyish). Four such band-like markings are found on either side. On the sides of the hind quarters the spots are shorter, some solid, some with a greyish central spot. Further down on the hind legs the spots become gradually smaller and more or less confluent into transverse bands extending also to the insides of the legs. On the fore legs the markings are less regular. A black transverse band is seen below the vertical stripes, and sometimes the spots are confluent into (wavy) bands there as well. On the feet the spots are much diminished in size, but small spots are scattered down to the toes. The soles of the feet are dark smoky brown. The underparts and the insides of

the legs are white (not pure as in *nicaraguæ*) but the under fur is smoky grey everywhere, which gives a certain shade to these parts. The sides of the neck, outside the four upper bands mentioned, show several longitudinal black lines. Some similar lines extend across the lower throat and the lower side of the breast behind the shoulders is densely marked with broad black spots partly confluent longitudinally. This spotting leaves only the hindmost portion of the abdomen unspotted and only shaded by the dark under fur. The tail is black along the upper side but by means of lateral greyish buff to whitish spots, not always opposite, divided into about eleven rings, which are mostly confluent and broader than the light spots.

The type is No. 10.5.21, Naturhistoriska Riksmuseum, Stockholm. The length of the skin is: head and body about 74 cm., and of the tail 44 cm. The terminal "spine" or "claw" of the tail is not less than 3½ mm.

The following cranial measurements are fully comparable with those recorded for Allen's *nicaraguæ*, because the type of the same was just as the present specimen, an adult male; the Ecuadorian race proves in most cases to be somewhat larger: Greatest length of skull, 104+ mm. (occipital crest damaged); zygomatic breadth, 68: nasal length mesially, 21; interorbital breadth, 20.5; tip to tip of postorbital processes, 54.3; postorbital constriction, 35.5; breadth of brain case, 48.5; length of bulla, 22.2; mastoid breadth, 47.5; length of p^4, 11.5.

By this description it is proved that in Ecuador on the eastern side of the Andes lives one representative of each of the subgenera *Leopardus* (*pardalis æquatorialis*), *Margay* (*glaucula ludovici*) and *Oncilla* (*pardinoides andina*), thus three subgenera of spotted tigercats in addition to *Lynchailurus* (*pajeros thomasi*), puma, and others.

I take the pleasure of dedicating this new subspecies to Consul Ludovic Söderström, to whom we are so greatly indebted for the exploration of the fauna of Ecuador.

MYOPROCTA

With regard to their general color the members of *Myoprocta* may be divided into two groups, namely, the "reddish" or tawny-colored, and the "greenish-colored" ones. To the former belongs in the first rank *Myoprocta acouchy* Erxl. to which Thomas has declared (1920) *exilis* Wagl. and *leptura* Wagl. to be referable, and further my *Myoprocta* (*exilis*) *parva*. The former of these appears to have a wide distribution in the Lower Amazons and Guiana, while the latter is known from eastern Ecuador. The "greenish-colored" members or the *pratti* group comprise in the first rank *pratti* Pocock from the Marañon district of Peru, then *milleri* Allen from Murelia, Colombia, and *limanus* Thomas from Acajutuba, above Manaos, Lower Amazons.

Recently Consul L. Söderström has presented a couple of "greenish-colored" specimens of *Myoprocta* to the Royal Natural History Museum in Stockholm. They are from Archidona on the eastern side of the Andes in Ecuador, 2400 feet above sea level. These are, of course,

nearly related to the other members of this group, but differ at the same time from them all, so that they must be regarded to represent a local race. The streak behind the ear is said to be "bright yellow" in *pratti*, in the specimens from Archidona it is ochraceous orange or still more rufous in the other specimen. The Brazilian race, *limanus*, has no sharp line of demarcation on the sides of the belly as is the case in our specimens. In this respect our race resembles *milleri*, but it differs from the same in having the hairs of the throat light to the base, while the former (fide Thomas) has "broad brownish slaty bases" to these hairs. I take the liberty of naming this race:

Myoprocta pratti archidonæ subsp. nov.

Upper side with a general color of olive green produced by pale yellow rings to the black hairs. Dorsal area a little darker than the sides. The face and crown are strongly suffused with brighter, more orange yellow rings to the hairs, and this color prevails on the sides of the head. Streaks behind ears ochraceous orange. Lower cheeks almost cadmium yellow, only with some few fine blackish tips. The ventral surface generally is a little paler, about light cadmium yellow. Chin very short-haired, whitish. Upper throat white, continued downwards with scattered white hairs but without full connection with the mesial white stripe, which is quite narrow. There is a slight shading to the yellow of the ventral surface in some places by means of tiny brownish tips to some hairs, but all hairs are light to their bases. On the front side and internally on the thigh there is a band of richer yellow, inclining somewhat to orange, running down to the front side of the tarsal joint. The area below vent is dull ochraceous orange. The legs are finely speckled with yellow rings to the brownish black hairs down to the bases of the toes, but the latter are uniformly black. The tail is black above, whitish or somewhat yellowish below, with the pencil mixed white and a little rufescent above.

The type, No. 17.3.21, Naturhistoriska Riksmuseum, Stockholm, is an old female with the following cranial measurements: Greatest length, 76.5 mm.; condyloincisive length, 67; zygomatic breadth, 36; mastoid breadth, 26; interorbital breadth, 21.5; length of bulla, 13; length of upper tooth row, 11.8.

These dimensions are in several cases very similar to those which Thomas has recorded for *limanus*. This is also the case with the length of the bulla, and as the author quoted says that this dimension of *limanus* is "markedly smaller" than in *pratti*, it follows that *archidonæ* differs from the latter in a similar way.

The geographic interest with this find is that two valleys not very far from each other on the eastern slopes of the Andes are inhabited by two different species of pigmy agoutis, the Napo valley by the "green" *M. pratti archidonæ* and the Curaray valley by the "red" *M. parva*. An analogy to this is that the *Dactylomys* of the valley of Curaray also is different from that of the Napo valley (cf. Lönnberg, Ark. f. Zool, Bd. 14, No. 4, p. 38. Stockholm, 1921).

Dicotyles[1] pecari æquatoris Lönnb.

When describing a new subspecies of this genus (Amer. Mus. Novitates No. 19), Mr. H. E. Anthony remarks that my type of the above mentioned subspecies was so young that some of the characteristics mentioned in the description may be due to immaturity. As I now have had the pleasure of receiving some more specimens of this animal, thanks to the generosity of Consul L. Söderström, and among the new arrivals also is a fully adult male, it is possible to support the validity of the subspecies from Ecuador and its standing. First, with regard to the color it may be stated that in one specimen the black, as in the type, reaches the tip of the snout above. In another the distal third of the snout is mixed in color but more white than black above. The chin and the upper lip are whitish with black sensory bristles and from the corner of the mouth whitish whiskers extend with their tips to below the interspace between eye and ear, but on the lower jaw the white hardly extends so far back as to occupy the whole of the interramal space.

When measuring the skull of the now received adult male of *D. p. æquatoris* I find that it is not so much longer than the young one, as I had expected it to be, because the total length is only 279 mm. The zygomatic width has increased to 122 mm., the breadth across the postorbital processes is 93 mm., and the length of the upper molar series 82 mm.

The lateral palatal flanges outside the premolars have increased in thickness, but have the same characteristic shape as described and figured for *D. p. æquatoris* with a sinuous outer contour line and with the same relation to the plane of the palate. M_2 is also somewhat broader behind than in front, unlike the case in the animals in Brazil and Paraguay. With the modification that *D. p. æquatoris* is not as big as expected, it appears to be valid as a subspecies.

Naturhistoriska Riksmuseum, Stockholm, Sweden.

[1] *Dicotyles* is a nomen conservandum (cf. Proc. Zool. Soc. London, 1924, p. 345–348).

A SYSTEMATICAL REVIEW OF THE RUSSIAN SABLES

By S. I. Ognev

[*Plate 26*]

The pretty and very valuable animal, the sable, has hitherto been very little known in its systematic relations, and in this paper I shall give a short review of its peculiarities. Thanks to the kindness of Mr. Bjalinitsky-Birula, Director of the Zoological Museum of the Academy of Sciences in St. Petersburg, I had the opportunity of studying the very fine collections of sables in that great museum, where I examined 354 skulls and 56 skins. Besides these, I have also examined a series of skins and skulls from the collections of the Zoological Museum of Moscow University and my own collection, as well as from the Museum of Fur-animal Industry, Moscow. In all I have studied 374 skulls and more than 100 skins of Russian sables.

To begin, we must establish the *terra typica* of the typical race of the sable. In his Systema Naturæ, ed. 10, 1758, C. Linnæus writes only "habitat in Asia septentrionali" (p. 46). If we agree to consider as the *terra typica* the first exact geographical indication after the tenth edition of the Systema Naturæ, then, as J. G. Gmelin (Nov. Com. Akadem. Petropol., vol. 5, 1760, p. 338) mentions the sables from the vicinity of Tobolsk, I think that it will be correct to count the northern part of the government of Tobolsk as the type region of the first race of the sable.

There is a decided variation in the coloring of sables. The mountain animal, which is comparatively short, is very dark, the tint of the underfur, which is of an obscure slaty-steel color, being especially characteristic. The sable of the forest and low country has not such dark, blackish fur, but is lighter and of a brownish hue; its dimensions are greater and its fur not so dense and soft as that of the mountain one. The Siberian swamp[1] (tundra) sable is the largest of all, but its fur is coarse and light, and its underfur is of a yellowish tint.

Martes zibellina zibellina (Gmel.)

The characters of typical *Martes zibellina zibellina* (Gmel.), 1760 (ex Linn., 1758), are the following. The skull is large, its total length being (♂♂) 87.3–89.6, (♀♀) 77.1–79.2; condylobasal length (♂♂) 84.1–89.2, (♀♀) 77.3–79.3; zygomatic breadth (♂♂) 48.9–53.2, (♀♀) 42.8; greatest breadth of skull (♂♂) 38.1–39.3, (♀♀) 34.6–34.8; length of skull capsula (from the strident interorbital)

[1] More exactly the north boundary of the Siberian forests.

(♂♂) 46.8–48.3, (♀♀) 45–45.2; length of bullæ osseæ (♂♂) 17.5–18.2, (♀♀) 16.1–17.3; breadth of mesopterygoid fossa (♂♂) 5.5–7.7, (♀♀) 6.2–6.7.

In structural peculiarities of the skull, the characteristic points are the length of the nasal part and the relative shortness of the skull capsula. In reference to total length of the skull the zygomatic width and the breadth at the postorbital processes are of no importance.

The color is dull and pale, the general tint varies from cinnamon-drab to pale brownish yellow and even to dark brown. Nevertheless, the underfur of the darkest-colored specimens is comparatively light and dull.

In the government of Tobolsk the sable is not rare in the taiga forests of the Pelym River; more rarely it inhabits the northeastern part of the district of Tjumen, along the Tavda River near its mouth; in the Tarsky district it is rare and is distributed in the taiga forests of Wasjugagje (according to J. Slovzow, The vertebrates of the district of Tjumen, 1892). According to S. M. Shugnov (1915), it is rare in the district of Surgut. At the end of the nineteenth century the hunters and trappers along the Jugan River obtained more than 300 sables during the year. Farther north near Beresof the sable is very rare. It is distributed along the sources of the rivers which flow into the Obi River from the Ural Mountains, and is completely absent between Beresow and Obdorsk. In the country among the rivers Omi, Tara and Irtish, and in the southern part of the government of Tobolsk it is very scarce (P. Stepanov, 1886).

The Ural sable, which spreads sporadically and rarely along the west foothills of the Ural Mountains, forms a distinct geographical race, the systematic peculiarities of which can be determined only from a large number of skins and skulls. This animal differs from the specimens of Tobolsk by its shorter size, dense and dusky color of fur, the hairs of which are of a handsome gloss, and by the very bright and fine throat patch. This sable, according to Mr. Belousov (1915), is the finest in western Siberia. The geographical distribution of the Ural sable embraces the river sources of Shugora, Laga, Jlicha and Petshora. It is also mentioned by certain authors as existing in the upper part of the rivers Kolva and Vishera. In the eastern part of the Ural Mountains, it is rarely met with at the sources of the Losiva River and also of the rivers Aspia, Purma, Ushma, Toshemok and Wishaj.

Martes zibellina yeniseensis subsp. nov.

The second distinctly different subspecies is the Yenisei sable, *Martes zibellina yeniseensis* subsp. nov. The type-locality: Krasnojarsk district, the forest on the plain along the Yenisei River. The type is No. 5378, Zoological Museum of the Academy of Sciences, St. Petersburg; collected December 11, 1892. The diagnosis of this sable follows: it is near to *M. z. zibellina*, but differs: 1, by a shorter nasal region of its skull; 2, by the concise anterior part of the skull region from the line between the tips of the postorbital processes to the front alveolar margin of the incisors; 3, by its comparatively larger and longer skull capsula; 4, in the relation of the length of the skull to the width of the wide spreading zygomatic arches and the postorbital processes. Total length of skull (♂♂) 83.2–88.7, (♀♀) 73.2–77.2; condylobasal length (♂♂) 80–84.3, (♀♀) 72–77; breadth of zygoma (♂♂) 48–52.1, (♀♀) 42–44.1; greatest width of skull

(♂♂) 36.4–39.1, (♀♀) 34.7–35.3; length of skull capsula (♂♂) 43.1–49.1, (♀♀) 42.1–44.8; length of bullæ osseæ (♂♂) 16.3–18.2, (♀♀) 15.6–16.8; breadth of mesopterygoid fossa (♂♂) 6.8–8.1, (♀♀) 5.7–7.2.

Its color is of a more dusky warm-brown in comparison with the light-colored sables from the government of Tobolsk.

Its geographical distribution embraces the great forests of the districts of Krasnojarsk, Ashinsk and Kansk. On the Tunguska River and near Turuhansk, probably, lives an undescribed distinct subspecies.

Martes zibellina sajanensis subsp. nov.

The sable from the Sajansky Mountains, *Martes z. sajanensis* subsp. nov., is quite distinct. The type locality is the Orsyba River, northern part of the Sajansky Mountains. The type is No. 9705, Zoological Museum of the Academy of Sciences, St. Petersburg; collected November, 1915.

Diagnosis.—The skull is markedly shorter than that of the sable from the Krasnojarsk district. The nasal part is shorter; the constriction behind the postorbital processes is narrow; the skull capsula is not long. Total length of skull (♂♂) 83.2–84, (♀) 74; condylobasal length (♂♂) 81.6–82, (♀) 73.2; zygomatic breadth (♂♂) 47.5–50.2, (♀) 43.6; greatest breadth of skull (♂♂) 36.2–37.4, (♀) 33.5; length of skull capsula (♂♂) 42–46.9; length of bullæ osseæ (♂) 16.6, (♀) 16; width of mesopterygoid fossa (♂♂) 6.7–7, (♀) 6.

The general color of the most common type of this sable is dark brown, the underfur of a light yellowish-pale color. The throat patch varies in its tint; in some specimens it is dusky, without a marked difference from the coloring of breast and flanks, in others it is of a very fine and brilliant salmon color. The geographical distribution of this animal extends over the mountain country of the rivers Uda, Kasyr and especially of the Kasyr-Suk and partly of the Usa.

Martes zibellina princeps (Birula)

Undoubtedly the prettiest sable is the one from the trans-Baikal country, the so-called Bargusin sable, *Martes z. princeps* (Birula) (1916).[2] The type-locality of this subspecies is the mountain country of Bargusin.

Diagnosis.—The skull is comparatively not large; in its structural peculiarities it is near that of the sable from the Sajan Mountains, but differs in its much greater bullæ osseæ and by the long skull capsula.

Total length of skull (♂♂) 79–85.2, (♀♀) 75–76; condylobasal length (♂♂) 78.2–83.5, (♀♀) 74.2–75.3; breadth of zygomatic arches (♂♂) 41–50, (♀♀) 39–44; greatest breadth of skull (♂♂) 34.4–37.6, (♀♀) 32–35.3; length of skull capsula (♂♂) 45.5–49.1, (♀♀) 44–45.6; length of bullæ osseæ (♂♂) 17.2–19, (♀♀) 15.7–16.8; breadth of mesopterygoid fossa (♂♂) 6.1–7.3, (♀♀) 6.3–6.6.

The color of its splendid, soft and silky fur is of a brilliant dark black-brownish hue; the underfur dark bluish gray with a brownish tint at the bases and still more brownish at the tips. The throat patch is much reduced and commonly not visible.

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[2] See Compte-rendu du Musee Zoologique de l'Academie Imperiale des Sciences de Petrograd, pour l'annee 1916, p. 08.

1. MARTES ZIBELLINA ZIBELLINA. *2.* MARTES ZIBELLINA KAMTSHADALICA.
3. MARTES ZIBELLINA YENISEENSIS. *4.* MARTES ZIBELLINA SAHALINENSIS.

This handsome most valuable sable is distributed in the mountain forests of Transbaikalia, more precisely, in the Bargusin Hills and in the branches of the Stanovoy Mountains. Formerly this sable was common in the country between the rivers Olekma and Witim; at present it has almost disappeared there. It is possible that the sables from the environs of Albasine, from the Zea River, and from the Bureya Mountains, which are also very dark in color, and costly, are identical with the *M. z. princeps*.

Martes zibellina kamtshadalica (Birula)

The Kamchatka sable, *Martes zibellina kamtshadalica* (Birula) (1918),[2] was very briefly described by A. Birula from Kamchatka. The type is in the Zoological Museum of the Academy of Sciences, St. Petersburg.

Diagnosis.—The skull differs from all of the remaining subspecies by its very great dimensions. The nasal region, the forehead, and the zygomatic arches are wider than in the remaining forms. The occipital capsula is longer. The bullæ osseæ are long. The inner lobes of m′m′ are greater than in the remaining sables, the dentes sectorii comparatively more robust. Total length of skull (♂♂) 89–95.7, (♀♀) 82.7–84; condylobasal length (♂♂) 86.1–93.3, (♀♀) 78.6–84.1; breadth of zygoma (♂♂) 48–56.8, (♀♀) 45.2–48.1; greatest breadth of skull (♂♂) 37.6–40.7, (♀♀) 34–37; length of skull capsula (♂♂) 47.1–51.3, (♀♀) 45–47.7; length of bullæ osseæ, (♂♂) 17–19.9, (♀♀) 16.0–17.8; width of mesopterygoid fossa (♂♂) 6.2–8.2, (♀♀) 6–7.2.

The general color is between warm sepia and mars brown, the underfur a pale yellowish gray. The throat patch varies in size, tint and intensity.

This largest sable is widely distributed in Kamchatka, especially in the Petropavlovsky district. It is possible that the rare sable from the Gishiga belongs to this subspecies.

Martes zibellina sahalinensis subsp. nov.

The lightest colored is the Saghalien sable, *Martes zibellina sahalinensis* subsp. nov. Type-locality: Saghalien, Wedernikovo. The type is No. 2688 (9695), Zoological Museum of the Academy of Sciences, St. Petersburg; collected November, 1881, by J. S. Poljakov.

Diagnosis.—The skull is comparatively weak, fine, strongly contracted in the interorbital region. By this peculiarity it is easily distinguished from *M. z. princeps* and *M. z. sajanensis*. The bullæ osseæ are also shorter than in *M. z. princeps*. The space between the postorbital processes (from their tips) is comparatively shorter than in the allied subspecies; the constriction behind the postorbital processes is greater; the teeth are weak.

Total length of skull (♂♂) 82.5–84, (♀) 77.9; condylobasal length (♂♂) 79–81, (♀) 76.3; breadth of zygomatic arches (♂♂) 45.2–47, (♀) 38.7; breadth between the upper borders of the orbits (♂♂) 16.9–18.3, (♀) 14.8; breadth between postorbital processes (♂♂) 20.9–21.6, (♀) 16.8; greatest breadth of skull (♂♂) 34.1–34.9, (♀) 32; length of skull capsula (♂♂) 45–45.2, (♀) 44.9; length

[2] See the Compte-rendu du Musee Zoologique de l'Academie des Sciences de Petrograd, pour l'annee 1918, p. 82.

of bullæ osseæ (♂♂) 15.7–17, (♀) 16.8; breadth of mesopterygoid fossa (♂♂) 6–6.1, (♀) 6.2.

The color of winter specimens is nearly the same as of the Kamchatka sable, but is of a more decided cinnamon tint and lighter. The throat patch is also of the same cinnamon color (something between pinkish cinnamon and light pinkish cinnamon). The head is of avellaneous tint or pinkish cinnamon, the back darker (from mikado brown to verona brown). The flanks sayal brown or tawny-olive. The underfur is light pale yellowish at the bases and more cinnamon at the tips. The summer fur is duller and darker, more brownish; the general tint is between natal brown and verona brown; underfur darker; throat patch more conspicuous.

The sable is a common animal on the whole Saghalien Island. The Ussuri sable is, probably, very near to the described subspecies.

Zoological Museum, Moscow University, Moscow, Russia.

GENERAL NOTES

A DELAWARE RECORD OF THE MASKED SHREW

Between Cape May, New Jersey, where the masked shrew occurs, and the environs of Washington, D. C., where *Sorex longirostris*, *Sorex fontinalis* and *Microsorex winnemana* have been found, intervenes a region that seems in need of systematic trapping for long-tailed shrews. Accordingly I record, as a beginning, a specimen of the masked shrew (*Sorex cinereus*) which, on November 25, 1924, entered one of my traps set in a sphagnum bog at the northern edge of a wooded slope about 3 miles east of Newark, Delaware. Newark is 78 miles, following the line of the Baltimore and Ohio Railroad, from Laurel, Maryland, where *Sorex fontinalis* has been recorded (Bailey, Mammals of the District of Columbia).—Morris M. Green, *Ardmore, Pennsylvania.*

BATS CAUGHT BY BURDOCKS

A note by Leslie T. Little (Auk, vol. 42, p. 284, 1925) on birds, and incidentally one bat, being caught by burdocks recalls a similar occurrence with regard to bats which I saw in 1892. In an old abandoned structure known as Benham's Mill, Rock Island Arsenal, Illinois, numerous bats of a small brown species, probably *Myotis lucifugus*, used to find their abode. Near the mill was a large clump of burdocks. On one occasion I noticed at least a dozen bats of apparently the same species that lived in the mill caught by the burdock burs. They were quite dry and mummified by the summer sun. No birds were caught with them.—Marcus Ward Lyon, Jr., *South Bend, Indiana.*

UNUSUAL NESTING OF A RACCOON

On April 26, 1925, while I was examining the timbered bottomland of Cherry Creek, near Parker (about twenty miles south of Denver), Colorado, my attention was attracted by faint squealings which came from a magpie's nest about twelve feet above the ground in a scrub oak.

At first I mistook the cries to be those of very young magpies and I climbed up to the nest to destroy the young, for they are an unmitigated nuisance with us. I was about to insert a hand into one of the "doors" of the nest, when my eye caught sight of *fur* through the interstices of the nest; then a quiet, prolonged and careful examination of the nest disclosed in it a large raccoon, presumably a female, about and over which several (number not determined) naked and blind young crawled, squealing and nuzzling about in search, probably, for dinner. I was glad to retire quietly from the situation and leave the family to follow its destinies without aid or hindrance from me. I am not familiar with the literature bearing on nesting places of the 'coon, but all such nests as have come under my observation have been in hollow trees or logs. It is interesting to speculate on the reasons for this particular 'coon's choice. There are few very large trees growing along Cherry Creek and these are all cottonwoods, which are not given to having hollow trunks, hence I imagine that raccoons along this watercourse are hard put to find suitable and safe nesting places. The magpie's nest in which this 'coon raised its young was an ancient one of extraordinary dimensions with the domed roof very thick and strong; the interior really made a cavity to be compared almost with a hollow in a tree. Certainly the little ones were safe from all enemies except perhaps skunks or weasels which might discover the nest at night during the owner's absence in search for food.—W. H. Bergtold, *Denver, Colorado.*

MUSTELA ALLEGHENIENSIS IN NORTH CAROLINA

In order that the information may be available to those interested in the distribution of the weasels I would like to report the occurrence in North Carolina of a weasel allied to *Mustela rixosa* and which appears to be *allegheniensis* as described by Rhoads. Until a specimen was brought to me I had never heard of this weasel being found south of Virginia but now believe its distribution will eventually be found to extend to the mountains of northern Georgia and possibly northern Alabama and undoubtedly the mountains of eastern Tennessee.

My specimen (now deposited in the U. S. Biological Survey collection) was number 915 in my collection and is an adult female taken near Marshall in Madison County, North Carolina, at an altitude of about 1700 feet, on April 17, 1916. Measurements are: total length, 183 mm.; tail vertebrae, 31 mm.; hind foot, 21 mm.

The pelage shows no indication of seasonal change, the fur having practically the same coloring as summer specimens from Pennsylvania. During my residence of ten years at Marshall I never heard of a white weasel having been seen, yet this is not very good evidence that the small weasels do not change color in this state for they apparently are quite rare.—M. L. Church, *Charlotte, North Carolina.*

TREE-CLIMBING AND INSECT-EATING WOODCHUCKS

In the May number of the Journal, Mr. C. Lee Shilliday once more brings up the ever recurring question of the tree climbing habit of the woodchuck. For years the sporting magazines have printed arguments on this subject; it ranks with another often debated one as to whether the mountain lion, puma or cougar screams.

On and off for forty years I have studied and hunted the little "Red Monk" and the past few years I have averaged fifty kills, so I figure I am qualified to testify in this matter. Yes, the woodchuck can climb a tree, but to drive him any distance up a tree he must be caught away from his burrow and hard pushed by man or dog. Even at that I have never seen one more than ten to fifteen feet from the ground. I occasionally find one sunning itself anywhere from four to eight feet from the ground on a leaning tree or fence post.

While on the subject of the woodchuck I would state that only recently have I discovered this animal to be an insect eater. This spring (1925) we have had an unusually large visitation of the large brown beetle known as the June bug, and I had noticed about the entrance of various burrows excrement containing undigested parts of these beetles. At first I was suspicious that this represented the droppings of skunks but later I punctured a woodchuck with a 30-30 bullet and scattered about, with blood and other matter, a quantity of parts of these same insects. The woodchuck is classed as a strict vegetarian and if the June bug was a small insect it would be possible for the animal to take it in with clover and its other food but this beetle is a large bulky one and furthermore I found too much in the droppings for this occurrence. My observations may be exceptional but certainly were not caused by a lack of food for the spring rains fostered a bountiful food supply.—CHARLES A. GIANINI, *Poland, New York.*

WOOD RAT DAMAGE TO FRUIT TREES IN EASTERN OREGON

About 10 miles north of Baker, Baker County, Oregon, a small abandoned orchard is located on the slope of a hill alongside a small ravine, which here opens onto an extensive plain. The whole surrounding region is covered with sagebrush, but a small spring drains through the orchard, furnishing it with water. Many rocks outcrop on the sides of the adjoining hills, providing homes for rock-loving animals.

During late June, 1922, an expedition from the Michigan Museum of Zoology camped for several days in this orchard. We noted that the bark of many of the trees had been gnawed by some small animal, the tooth marks being too small for those of a porcupine. One night about midnight I saw some animal gnawing on the limb of an apple tree over my head, and the next day I set a steel trap at the base of the tree; during the night this trap caught an adult female wood rat (*Neotoma cinerea occidentalis*). There can be no doubt that this species is responsible for the damage done to the trees.

Both apple trees and cherry trees grew in the orchard and both had been damaged. One cherry tree in particular had been severely injured, and many good-sized limbs of the other trees had been completely girdled. Also the bark had been completely removed from many of the smaller branches.—L. R. DICE, *University of Michigan, Ann Arbor, Michigan.*

NOTES ON THE TREE MOUSE, PHENACOMYS SILVICOLA

In the May number of the JOURNAL OF MAMMALOGY for 1921 (vol. 2, p. 98), occurs the description by Mr. A. B. Howell of a new species of *Phenacomys* from Oregon. The present writer has since been able to collect information which not only extends the distribution of this species, as Howell predicted might be done, but which also makes it possible to add further data regarding its habits.

In the spring of 1924 the writer's class in zoological collecting made a rather intensive study of a valley and its adjacent ridge leading out of the Willamette Valley into the foot hills of the Coast Range Mountains, Oregon. While the goal set for the term's work was to make as complete a survey of the bird and mammal life as possible in the time available, special emphasis was given to two genera, *Zapus* and *Phenacomys*, owing to the fact that in 1915 the writer gathered uncertain information regarding a red mouse which had been found by wood cutters who were working in the valley mentioned above.

The trap lines were eagerly investigated for these animals at each visit. The *Zapus* was never taken; but on April 24, while making a tour of the higher shoulders of some of the ridges, the class in two groups and the writer by himself simultaneously noticed a nest in a fir tree about forty-five feet from the ground. All recognized it as something new, and Mr. E. D. Platt volunteered to climb the tree and make an investigation. The ascent of a two-foot Douglas fir to the height of forty-five feet with neither climbers nor rope is not an easy feat but it was accomplished. The top of the tree had been broken off several years previously and a decayed stump remained. On the top of this stump was heaped a mass of small twigs and lichen which was approximately one foot in diameter. This mass, which was at first taken for the nest, was found empty. Further search disclosed the nest which was composed of shredded lichen about six inches down inside the cup of the stump. It contained four young mice well covered with hair and readily recognized as belonging to the genus *Phenacomys*. These were removed and three mouse traps were thrown up to Mr. Platt who set them on horizontal limbs coming from the sides of the stump. The next day the tree was visited and the mother was found hanging from one of the limbs held in the trap which had caught her by a hind leg. The traps were reset with no results and a careful examination of the entire community has not shown further evidence of this species.

Great care was taken to raise the four young and although they apparently thrived on a diluted mixture of cow's and goat's milk they suddenly weakened and at the end of a week all died and were preserved in alcohol. The mature adult female, which has been identified as *Phenacomys silvicola* by Mr. A. Brazier Howell, is preserved as a museum skin. Microscopic examination of her stomach contents showed fir needles, bark, and lichen, all in a finely pulverized condition.

As far as is known, this is the second specimen of *Phenacomys silvicola* that has been collected, and the first to be taken east of the Coast Range. It is interesting to note that Mr. Howell's predictions, that this species is undoubtedly arboreal and that it would probably be found elsewhere in the humid timbered areas of the state, have so soon been verified.—H. M. Wight, *Oregon Agricultural College, Corvallis, Oregon.*

THE PÉRE DAVID DEER HERD

While in England in May, 1922, I visited Woburn Abbey, the Duke of Bedford's estate, to see the Pére David deer. I had heard that there were only about half as many as before the war and I was anxious to see for myself. The head keeper took me around and showed me the deer, which were divided into three separate bunches. One bunch contained mostly females and young of the year; another was an assortment of mostly smaller males, and the third contained

eight or nine of the best males. In all there were forty-seven adults, one of which was a partial albino, and the keeper told me that they had already had one other albinistic specimen. He said there were seventeen fawns born that spring, three of which were born dead and two had died since (May 9th), leaving twelve fawns, all about the same age. One of them was born the last of March and the rest in April. All of the males had antlers nearly full grown at the time of my visit, but almost all with the velvet still on. The most advanced males were just shedding their velvet. They have a very peculiar gait hard to describe, slow and stately and accompanied by a loud clicking of the hoofs like caribou, and this sound can be heard a good way off, certainly a couple of hundred yards or more. The herd seems to be holding its own and the animals look in good condition, and on casual inspection show no ill effects from inbreeding, with the possible exception of albinism mentioned above.—JOHN C. PHILLIPS, *Wenham, Massachusetts.*

RECENT LITERATURE

Skinner, M. P. BEARS IN THE YELLOWSTONE. A. C. McClurg and Company, Chicago. 12 mo., pp. 158, pls. 36. Cloth, $2.50. May, 1925.

America has been unfortunate in its paucity of naturalists of the type who study and live with a subject for years and then make the results of their observations available in book form for others. Such naturalists have long been characteristic of Europe, particularly of England. "Bears in the Yellowstone" is the work of a naturalist of this rare type, and is the result of his intermittent studies of bears in Yellowstone Park for a period of thirty years. It is a natural history of the bears written in a clear and pleasing style, perfectly adapted to the layman, yet withal nowhere displaying that laxity with truth and that effort to humanize animals so frequently evident in popular works on natural history.

Skinner introduces several amusing narratives into his story of the Yellowstone bears, but for the most part he gives us a straightforward, interesting account of why the bears are famous, what they do in the wilderness and around the camps, what they eat and drink and how they get their food, in general, how bears live. It would hardly be advantageous in a work of this style to go into detail about the various species (possibly four) of grizzly bears in the park. The habits of these as individual species or even their specific field recognition marks are unknown. But would it not have been better at least to have mentioned the two species of grizzlies (namely *Ursus horribilis imperator* and *Ursus mirus*) *known* to inhabit the park, rather than to have stated definitely "there are only two kinds of bears in Yellowstone Park—the black bear and the grizzly"? These two species of grizzlies are as different taxonomically as many species of small mammals that are accepted without question.

At the close of the book is a list of the fifty-seven species of mammals known to inhabit the park, with very brief notes on their habits and identification marks. The many halftones are an attractive part of the book, but a number of them have an indistinct, fuzzy appearance undoubtedly produced for an artistic effect not appreciated by one who likes things as they are.

—*Hartley H. T. Jackson.*

Scott, George G. THE SCIENCE OF BIOLOGY. Thomas Y. Crowell Company, New York. 8 vo., pp. xii + 617, text figs. 355. Cloth, $3.50 net, postage extra. 1925.

In this book we have a laudable effort to present an introductory study to the whole subject of biology, a work needed in these days of so many texts of divided interests in botany or zoology. In most respects the text is excellent. The order of treatment is logical, the first part being devoted to definitions, and chapters on protoplasm and the cell. Then follows a part on plants, from the lowest to the highest. The third part is devoted to animals, while the fourth and last considers the broader questions such as distribution of life, heredity, genetics, evolution, and the biology of man. These later chapters, especially the ones on physiology, heredity, adaptation and evolution, and the biology of man are particularly commendable. In many places in the book, however, there is an apparent effort to overdo simplicity, with the result that sometimes the meaning is not clear and often the text reads like a school boy's first attempt at an English essay. For example, "Armadilloes eat worms and insects. Strong claws for burrowing are present. The tongue is long and can be protruded. The Anteaters (*Myrmecophaga*) are hairy forms. There are no teeth present and the skull is elongated and tapering. The tongue is very long and is used for 'licking up' ants. The forefeet have long claws for scratching open ant hills. The tail is long. Some forms are *arboreal*. They have prehensile tails. Anteaters are found in South America."

It strikes the reviewer that Professor Scott could have avoided numerous errors and misleading statements had he referred the text on the different classes of animals to specialists for review before publication. In the chapter on Mammalia we find such statements as the following: The tail of the beaver "is used as a trowel in plastering mud in the construction of dams." Pocket gophers "rob the grain." "Rocky Mountain goats are still found in British Columbia," as if they were *not* anywhere else. "There are only about two thousand specimens [of bison] in existence today," when there are more than six times that number! The raccoon is placed in the family *Canidae*, though actually it is not closely related to the dog tribe. And, apparently on account of poor editing, we find the badger, marten, and weasel classed with the *Ursidae*!

The plan of the book is good, and the illustrations for the most part are clear and to the point. It is to be hoped that in another edition some of the defects may be eliminated, in which case the work would be very much worth while.

—*Hartley H. T. Jackson.*

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